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Coordination of Fleet Battle Experimentation and Joint Experimentation Programs

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COORDINATION OF FLEET BATTLE EXPERIMENTATION AND JOINT EXPERIMENTATION PROGRAMS

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EXECUTIVE SUMMARY

BACKGROUND

The Fleet Battle Experiments (FBE) are CNO-initiated series of operational experiments for the purpose of examining emerging systems, technologies and concepts. The Maritime Battle Center (MBC) of the new Navy Warfare Development Command (NWDC) is the CNO's agent for planning and implementing these experiments in conjunction with the numbered Fleets. FBE-E is the fifth in the series and is under the operational sponsorship of Commander Third Fleet (COMTHIRDFLT) in San Diego. The Naval Postgraduate School (NPS) performed assessment for FBE-E during March and April 1999.

CONCEPTS AND EXPERIMENT APPROACH

NPS has performed assessments for several Joint Warrior Interoperability Demonstrations (JWIDs) and routinely for the ONR Adaptable Architecture for Command and Control (A2C2) laboratory experiments. NPS personnel were also involved in the All-Service Combat Identification Evaluation Team field tests in 1995 & 1996. The Modular C2 Evaluation Structure (MCES) is a tool developed at NPS in conjunction with the Military Operations Research Society (MORS) for stepping through quantitative assessments that has applicability for FBE-E. NPS has conceptually applied the MCES in helping to define measures to gauge the success of each of the major areas of FBE-E.

Although the FBEs are labeled Experiments, they are not laboratory experiments but are operational experiments or better yet, explorations of new concepts, technologies and processes. In FBEs to date there have seldom been opportunities for experimental replication (several runs under controlled conditions) or control groups that constitute the standard case or experimental designs that systematically vary the very large number of factors in the operations. Usually the base case or standard is simply the "usual process and results". Perhaps more important than whether the specific experimental processes worked in this FBE, are the insights into how they can be made better for the next FBE.

MAJOR RESULTS

- Embarkation of the MIUW Van extended organic and inorganic sensor range and allowed it to be used in the Littoral Zone of Interest without having to establish a secure rear area for MIUWU protection.

- Utilization of the UAV for detection, identification, and tracking had remarkable value. High quality imagery of mobile targets was almost continuously available to the Harbor Defense Commander, Full Dimension Protection Cell and others. A combat swimmer was detected by the UAV while at altitude.

- Changes in tactics that compensates for arc and range of fire and improved identification methods are needed to prevent fratricide of HVA defenders and take into account possible collateral damage both over water and ashore.

- NCASW increased force situational awareness through distributed advance search plans.

- Reliable networked communications are essential for Distributed Collaborative planning (DCP) in NCASW.

- Common tactical decision aids and common understanding of the DCP process are enhance the update of situational awareness required for NCASW.

- Laws demonstrated flexibility and ease of use. While the system was by no means fully exploited, it performed well for the functions utilized during this experiment.

- Deconfliction requires further investigation. DAMS was not successfully electronically interfaced to LAWS. Full implementation of algorithmic procedural deconfliction in LAWS may yield improvement over current methods and be more efficient than DAMS. Any deconfliction system requires an adequate visualization tool to be useful. No methods currently address latency issues.

- Naval Surface Precision Fires weapons currently in use or programmed are not useful in the Urban Canyons.

- NCASW increased force situational awareness through distributed advance search plans.

- Reliable networked communications are essential for Distributed Collaborative planning (DCP) in NCASW.

- Common tactical decision aids and common understanding of the DCP process are enhance the update of situational awareness required for NCASW.

- DARPA One Way Multi-Lingual Interview System shows promising utility.

- The Center of Excellence in Disaster Management and Humanitarian Assistance (COE) using proprietary software SoftRisk enabled interface with CMOC's similar information system based on Lotus Notes with the emergency response network.

- WMD identification, real time METOC data, and real time feed of WMD indications/ warnings/analysis are required for command management of WMD .

EXPERIMENTATION ISSUES

The process of naval concept development is supported by experimentation, partially in the FBEs, but also in games and LOEs. In order to perform even operational experiments, an analytical framework, which identifies the issues to be addressed and the possible indications of the results, is required. Therefore FBE's have identified hypotheses and measures of effectiveness. Although to a large extent these have not been testable, it is largely because the treatments (new systems to be introduced) and the conditions (the scenario and fleet actions) have not been able to be accomplished in the actual FBE. Experimentation requires an experimental test bed. In FBE-Echo circumstances did not allow dedicated experimentation along the lines planned. Moreover many of the planned new systems were either not available or not serviceable in the environment. Future FBEs must be protected from these factors if the results are to be complete and credible.

RECOMMENDATIONS

Further testing of MIUW Units on mobile platforms is indicated. Improved communications and sensor architectures and network connectivity require further study.

Methods and or tactics for protection of HVA that minimize collateral damage and guard against fratricide need to be developed and evaluated.

Fully integrate UAV control into the command network to enhance dynamic and broad use of a valuable tactical sensor.

Further experimentation on network centric antisubmarine warfare to include integration into the full dimension protection concept and also to include tracking of white shipping.

Deconfliction methods integrated into the weapons network that are visual and simply displayed should be developed and evaluated in future experiments.

Command and Control policy and architectures for sensors and sensor coverage need to be developed and evaluated. Develop and use an automated method of cueing of changes in command and control posture and sensor allocation. This could facilitate timely and dynamic reallocation of sensors in the grid to adequately response to changing threat levels in the battlespace.

Precision strike weapons need to be developed and evaluated for their use profiles and potential for collateral damage.

EXPERIMENTATION

ANALYSIS METHODOLOGY

FBE Echo was defined by high-level goals from which lower level or more detailed operational concepts called themes were developed. Using these themes, hypotheses and measures were enumerated. This conceptual framework contributed to the construction of a data-capture plan and follow-on evaluation.

In general, when dealing with complex systems, system complexity increases as the focus moves from the abstract concepts to the system components. One impact of this complexity continuum is a necessity for the data gathering and analysis processes to become similarly complex. FBE Echo provided an opportunity to determine the scope of data gathering and evaluation requirements and to study how they might be refined for implementation in future experiments.

The Naval Postgraduate School effort for data collection in FBE Echo was an experiment within an experiment. The effort was geared to integrate the development of the assessment plan and the development of the data capture plan with the development of the experiment plan.

The complexity of the experiment planning process however as well as the dynamics of the changes to execution plans resulted in mismatch between scheduled events and the data collection plan. In some cases assets were required for experimental uses that incapacitated scheduled data capture without the knowledge of the assessment team until well after the fact.

These experiences highlight the need for using an autonomous data capture scheme coupled with a data archival system and knowledge management methodologies to maximize support for updating analysis of initiatives. A single experiment does not produce the quantity of data for a full analysis of any one initiative. There is much useful data both qualitative and quantitative that can be gleaned from an experiment. NPS is in the process of developing the data archive capability to capitalize on the incremental addition of data and knowledge management \methodologies for subsequent initiative analysis update.

DATA CAPTURE TECHNOLOGY AND METHODS

An outcome of Fleet Battle Experiments is that the design of data capture methods and technologies are improved as the experiments are executed. What will accomplish the data capture task in any given experiment is the result of something learned in a previous experiment, or part of a well-established methodology taken from the domains of military exercise data collection. However, complex experiments, such as FBE Echo require multiple data capture methods.

Quantitative (electronic) and qualitative data were gathered in the course of FBE Echo. Quantitative data was recorded to establish "ground truth" in asymmetric interactions, which could then be used for modeling analysis and as part of further development of simulations. Two principal means employed to gather this data were GPS (Global Positioning System) and ADSI. (Air Defense System Integrator).

Portable (hand-held) GPS units were procured (approximately 20) for use by asymmetric forces, JTF PSU (Port Security Unit) boats and by two rental trucks posing as mobile SCUD-type missile launch platforms. The GPS units were equipped with a detachable memory on which GPS positions were recorded for a prescribed time step. A difficulty with this technology was that as the time-step was shortened, available memory for the platform's track was used more quickly, resulting in shorter times between change-out of memory. Detachable memory was downloaded from each GPS unit onto a laptop, for use in reconstructing a particular unit's track.

ADSI is a LINK integrator device, which fuses together inputs from LINK-11 and LINK-16 and presents a common operational (LINK) picture to the JTF Commander. USS CORONOADO was equipped with ADSI in FBE Echo, and the system output was an input to the COP (Common Operational Picture) in the Full Dimension Protection cell. ADSI has a data-recording feature that records LINK reports and stores them for later retrieval and data reduction. This database was retrieved post-exercise for analysis and reconstruction.

Qualitative data was gathered through multiple means and instruments. Each experiment pillar was defined around a set of concepts stated as hypotheses. Many of these hypotheses required observational data, questionnaires or debriefings. In addition, collaborative logs were collected where used. For example, COMPASS was used as a distributed collaborative planning tool between the Full Dimension Protection (FDP) cell on CORONADO and other units in the experiment. The log of these communications was collected at the end of the experiment. Similarly, an electronic log was maintained in the FDP cell and provided an excellent source of information for post-experiment analysis.

Questionnaires were developed relevant to specific participants in specific types of events, and filled out at the end of each event. These were used extensively in asymmetric events as a means to debrief OPFOR participants. Questionnaires were also constructed for various watch-stander roles throughout the experiment, but were less effective at gathering information.

Debriefings of participants in asymmetric attack, WMD targeting events, UAV support and other cells were particularly valuable in establishing the context of the experiment and contributed a great deal to the insights gained in the experiment.

DATA ARCHIVING, MODELING AND KNOWLEDGE MANAGEMENT

There is a tendency to treat major experiments as independent events, which produce final results for a specific set of questions. But, FBE concepts are broad and require a succession of experiments before obtaining final answers. We expect experimentation to lead to modification of many aspects of the operations concepts being tested over time. Concepts, procedures, systems, etc., will all be in evolution. This makes it important to have an analysis system, which is robust and complete in MOEs, parameters produced, and information archiving.

MARITIME DOMINANCE

ASYMETRIC THREAT

MAJOR POINTS

- Embarkation of the MIUW Van extended organic and inorganic sensor range and allowed it to be used in the Littoral Zone of Interest without having to establish a secure rear area for MIUWU protection.

- Utilization of the UAV for detection, identification, and tracking had remarkable value. High quality imagery of mobile targets was almost continuously available to the Harbor Defense Commander , Full Dimension Protection Cell and others. A combat swimmer was detected by the UAV while at altitude.

- Changes in tactics that compensates for arc and range of fire and improved identification methods are needed to prevent fratricide of HVA defenders and take into account possible collateral damage both over water and ashore.

CONCEPT

Mission Concept: Harbor Defense, Maritime Pre-positioned Force Protection (protection of High Value Assets (HVA) at sea or at offshore anchorage or in port) against asymmetric threats from combat swimmer attacks is a requirement in the asymmetric environment.

Operations Methods: Employ a boat with specialized sensors and flexible command and control capability to protect against asymmetric threats in port, at offshore anchorage, or in other littoral areas.

Use response forces in a layered defense to include armed patrol boats and Explosive Ordnance Disposal units under the command of the specialized boat to increase speed of response and defensive posture.

Use real time intelligence, surveillance, and reconnaissance data to achieve greater battlespace situational awareness to improve speed of command.

System Solutions: Slice boat, MIUWU (Maritime Inshore Undersea Warfare Unit) Van, Swimmer detection system, and Hand held sonar.

SUMMARY

MIUWU maneuverability was enhanced by being placed aboard an afloat unit (termed the SLICE boat). By being embarked the MIUWU was less vulnerable as a moving target and was able to relocate as needed, extending organic and inorganic sensor range. Embarkation also allowed the use of MIUWU in the Littoral Zone of Interest without having to establish a secure rear area for MIUWU protection.

However, it was also determined that some equipment did not function well on this mobile platform. A result from this experiment is that MIUWU equipment should be evaluated for use while embarked on a mobile platform. The evaluation should consider all expected mechanical issues, electronic functions and environmental effects. For example, contact with the MIUWU was lost when the SLICE boat accelerated. There were inherent satellite targeting problems associated with a moving platform, as well as stabilization issues with other equipment. Solutions to these problems would provide the JTF with an enhanced MIUWU capability, to be tested in a future FBE.

Defenders aboard an anchored high-value asset were confused about which boats to shoot when high-speed boats attacked the high-value asset and defending PSU boats engaged the attackers. Inshore Boat Unit (IBU) and Port Security Unit (PSU) assets need some form of IFF or tactic to separate themselves from the threat vessels.

Fratricide is a risk when the fields of fire for the IBU's and PSU's overlap during maneuvering to intercept incoming attackers. Fire directed from the high value unit against attackers may also be dangerous to a defending IBU or PSU not easily identified or too close to an attacking boat. This risk is multiplied in poor visibility due to weather or at night. The PSU's attempted to use the tactic of staying close to the HVU and using overlapping fire on attackers. Another tactic, "peeling off" away from attacking craft to allow the HVA to bring its defensive fire to bear was also attempted by the PSU's. Both tactics were demonstrated to be problematic in practice, leading to a post experiment definition of need for some form of electronic identification to be instantly recognized by both the HVA and defending units. A time-sensitive targeting concern is that there is a very limited time in which defending crews can respond to attacking fire. Indications and warnings provided by a system, which also provides identification information, might decrease the overall response time by reducing the identification time.

An overriding hypothesis for FBE Echo was that network-centric concepts could be used to advantage in the asymmetric environment. Indeed, from the MIUWU perspective this unit was able to use multiple sensors to detect, track and identify a jet-ski attack on a HVA at anchor in the littorals. However, from the PSU perspective there were problems related to the receipt and effectiveness of commands between the MIUWU and controlled units. Examination of message traffic loading during this portion of the experiment revealed very high message rates. However, PSUs noted in post-experiment questionnaires that very little of these communications were useful in their conduct of HVA defense and that there were limited pre-attack warnings. Poor communications between the MIUWU and PSU's contributed to the C2 difficulty and was evidenced by several of the boat drivers' inquiry as to whether jamming had been conducted by the OPFOR. Specifics related to this problem need to be defined. However, a more readily identifiable contributor to C2 problems the lack of headsets for PSU's to maintain two-way communication between themselves or MIUWU. Holding a handset while executing high-speed maneuvers is problematic at best. In post-experiment interviews PSU crews reported they reacted to self-identified in-theater threats, followed by execution of pre-planned tactics. The extent to which MIUWU provided situational awareness to defending units seems to have been limited due to a combination of difficulties. A limited objective experiment may help identify specifics of C2 system problems and provide insight to deconfliction tactics and technology.

As part of the WMD scenario, EOD-HQ tested CD-ROM analysis software and communications paths to provide this information to the field. Included in this communications system were TECDIV at Indian Head (?), the WMD cell aboard Coronado, EOD-HQ itself and the Response Team. The system was to provide historical images of WMD systems and a record of communications related to the present situation. The capability of this system could not be fully tested or demonstrated due to the lack of a satellite channel and poor RF conditions. Further complicating the WMD problem, Response Teams did not have chemical sniffers or other technical means to assess the threat on sight. Identification of these additional technical means and further tests are indicated, along with improvement in the C2 architecture to support connectivity between the multiple sources which are necessary to assess and neutralize the threat.

Swimmers attack against the HVA is another possible threat in the asymmetric environment, and defense against this threat was tested in FBE Echo. As part of a swimmer defense, a hand-held sonar has been developed but was unavailable for this experiment. Without the added technology, PSU's adopted a tactic of dropping overlapping grenade concussion patterns, but these actions did not result from swimmer detection, indications by any sensor or direction by the HVA or MIUWU. This part of the experiment highlighted the need for further testing of new equipment and tactics to counter this type of threat.

During early formulation of concepts of operations in response to asymmetric threats for the San Francisco Bay phase of the experiment, use of defensive helicopters in a ready five state would provide a major defensive capability. An initial definition of the concept was modeled using the General Campaign Analysis Model (GCAM). Model analysis demonstrated that if the helicopter was not airborne at the time of threat designation the helicopter would not be positioned to effect intercept. The impact of this early analysis was that helicopters were then not tested in the defensive tactic weapons for these scenarios.

MEASURES AND OBSERVATIONS

Hypothesis 1: Combat swimmers can be detected by the Mobile Inshore Undersea Warfare Unit (MIUWU) and other swimmer detection systems and countered by coordinated operations of the Port Security Unit (PSU).

NOTE: Swimmer Detection System that was to be tested during these events was not available. Therefore, this hypothesis was not satisfactorily addressed.

Measure 1: "The percentage of trials in which swimmers are detected before reaching unit and estimated range at which detected. Modes of detection and confirmation and time to sort and declare threat should be recorded. Swimmer mode (surface, open circuit and closed circuit) and visibility conditions should be noted."

Measure 1 Observations: Combat swimmer attack detection was conducted dusk to nightfall. No visible sign of attackers were detected. Two separate PSU simulated dropping concussion grenades at 40-yard intervals to have overlapping effect but these were not instigated by any sighting or cueing from higher authority.

Measure 2: Time between detection and prosecution by response force, including communication latency between the HVU and the PSU and time between alert and activate effective responses (weapon to bear on visually identified target at effective range).

Measure 2 Observations: No detection of any combat swimmers occurred during this scenario, primarily due to unavailability of the Swimmer Detection System. However, some understanding was gained for future examination of the physical domain in which data gathering and measurement of swimmer detection, defense and response will take place.

Hypothesis 2: Attached mines can be located more quickly using hand-held sonar.

Measure 1: Ratio of time to locate mines attached to ship with and without the sonar.

Measure 2: Utility of hand-held sonar.

Measure 1 and 2 Observations: Sonar devices were anticipated but unavailable for the experiment. A hull-search diving experiment with EOD was substituted. Conditions for the experiment were poor, in part due to communications difficulties (possibly due to EOD being located behind a building surrounded by a two story metal fence under the Oakland Bay Bridge). EOD responded promptly to notification of possible limpet mines deposited on the hull of the HVA, however a 2 ½ - 3 knot current and severely limited water visibility made retrieval of the limpets extremely difficult (mines were put in place during slack tide). Only one mine may have been detected and none were removed from the hull. Conditions on the following day were improved, but it still required several hours to remove the limpets. The experiment demonstrated the impact of environmental conditions on the ability of a trained and equipped EOD unit to counter the threat.

Commentary from EOD personnel and observers indicate that mission planning in this environment was challenged. The lack of reliable communications delayed critical information. When the environmental conditions are difficult and missions are executed individuals rather than groups, communications must be reliable and easy for any mission to be executed successfully. This experiment as well as others in the littoral points out the need for information flow by means of devices that are not affected by water, loud background noise, and the user actively engaged in performing the mission.

In summary, although the original hypotheses could not be tested due to lack of anticipated hand-held sonar equipment, insights were gained with regard to EOD requirements for countering asymmetric threat in difficult environmental conditions. These lessons learned point to the need for the development of next generation individual digital secure and non-secure communications devices.

Hypothesis 3: Networked multi-sensor surveillance and response forces in layered defense can counter asymmetric small-boat attacks.

Measure 1: Ranges at which attacks are detected and at which they are declared threats.

Measure 1 Observations: PSU tactic employed in the experiment against asymmetric small boat attack against the HVA was to first Intercept, Interrogate and Report (I^2R) boats within a range of 1000-1500 yards to the HVA. Boats continuing the approach to within 500-1000 yards were to be intercepted and steered/escorted out of the area. Within 500 yards targets were to be designated hostile and engaged with weapons. PSU's were oriented toward inbound threats to create overlapping fields of fire. Nominally, four defending PSU's were stationed at each quarter of the ship at a range of approximately 100 yards. If only two PSU's were available each would patrol a figure 8 pattern fore and aft of the ship.

Although incoming traffic was spotted and prosecuted according to the prescribed tactic, there was no white traffic in the harbor because of the issuance of a Notice to Mariners (NOTAM) for all shipping to remain clear of the experiment area. Initially, Coast Guard auxiliary boats were to be present in the engagement area to provide clutter and enhance the discrimination problem expected in an asymmetric scenario, but that did not happen. In addition, OPFOR used their easily recognizable SBU11 PBL's, reducing the identification and engagement problem within the experiment.

OPFOR success (attacking boats within range and in orientation to attack and damage the HVA) was determined subjectively. A more quantitative assessment of attack (or defense) success requires measurement of time-stamped OPFOR and defender tracks to yield the dynamics of interaction and elements of the engagements (i.e., how close opposing forces approached the HVA/defenders and their orientation during attack, interception or being fired upon). One purpose of the experiment was to gather data useful to reconstruction in a simulation model. Portable GPS units with time-stamped position recording capability were used for this purpose, and may be combined with additional data capture means, such as that from UAVs. NSWC Crane is currently developing a computer model using the GPS data that will be promulgated as a follow on addendum to this report. At a lower level, technology that allows determination of attack success (laser-designated hit detectors) would enhance unit-level play and provide additional data useful for experiment reconstruction in a simulation environment.

Observers in PSU's commented that C2 required by the MIUWU TAO embarked on the SLICE boat was problematic in maintaining coordination of defensive units in the course of the small boat attack. Lacking this coordination, PSU's reported that they responded to threats as they were perceived by the PSU's, not as directed by the TAO. Although the MIUWU TAO was observed making numerous communications during fast boat attack events, these communications were not consistent with boat crew designation of hostile targets or their prosecution of the threat. This implies a limited COP at the MIUWU, resulting in reduced situational awareness. In a threat environment where defining the threat and tracking multiple targets against a data noisy environment is most challenging, it is probable that current MIUWU C2 and maintenance of MIUWU COP would need to be enhanced. Additional testing will be necessary to determine the extent of capabilities and limitations associated with the concept of an embarked MIUWU and the C2 associated with the asymmetric domain.

Measure 2: Time to initiate response to potential (sometimes WMD) threat after threat is detected, engaged or device is planted.

Measure 2 Observations: Two WMD events occurred during the experiment. EOD tactic for countering a WMD involved vectoring a detachment to the threat site establishing an initial assessment of type of threat encountered and coordinating with EOD-HQ for follow on guidance. EOD-HQ computes a plot of possible lethality radius, down-wind threats, etc. and informs those affected. A notional detachment is equipped with HF and UHF equipment and a VDC-400 PC containing CD-ROM threat software for threat analysis. These capabilities are mirrored at EOD-HQ, with PSC-5 satellite communication equipment used for long range data communications. In the experiment the EOD command structure included a WMD cell on the CORONADO to act as liaison with EOD-HQ through the MIUWU van. EOD-HQ C2 was to employ satellite communications with experts at TECHDIV, Indian Head as well as with the CORONADO WMD cell. This connectivity was central to planning the defeat of the WMD threat on-line, using on-site communications and digital imaging.

In the first WMD experiment, EOD-HQ was notified of a possible WMD and deployed one detachment to the threat site. As previously mentioned, communications with EOD-HQ were characterized as intermittent by observers and participants. The WMD cell on CORONADO was not equipped to receive EOD transmissions, and as a result of unavailability of a satellite channel, reachback to TECHDIV, Indian Head was not possible. Despite C2 setbacks, the threat was assessed, lethality areas established, appropriate players notified and the threat neutralized per planned tactics. Performance measures of EOD response to WMD were not measured, however qualitative assessment of the COP and situational awareness shows validity of network centric principles applied to this threat. This was demonstrated in the second WMD experiment in which EOD personnel embarked on CORONADO set up to receive and transfer digital images and typed data as the engagement proceeded. Improved communications during this phase of the experiment enabled relay of real-time typed communications and digital imagery between the responding detachment at the WMD site, EOD-HQ and the CORONADO.

Measure 3: Perception of false alarms, fratricide and collateral damage risks.

Measure 3 Observations: One false alarm occurred when communications for another event were interpreted as a possible WMD threat. EOD responded but on reaching the site the mistake was apparent and none of the personnel at the HVU were aware of a WMD threat in the area.

Fratricide between PSU's was observed to be limited using tactics which spaced them at the fore and aft quarters of the HVU. This spacing prevents friendly vessels from coming within lines of fire unless a defender continued to fire after an incoming attacker was at a distance equal to, or inside the defender's patrol distance from the HVU. Fire from the HVU however, was determined to be a threat to defending PSU's. The prevention of collateral damage with the PSU .50 caliber machine guns, to neutral boats or other entities ashore or in and around the small harbor area, would have required further coordination between civilian and military planners.

Hypothesis 4: Networked multi-sensor surveillance and response forces in layered defense can counter attacks from personal watercraft (jet-skis).

Measure 1: Ranges at which asymmetric jet ski threats are detected and declared threats.

Attacks occurred during daylight hours with good visibility. Sensor technology to detect threats was not used by PSU personnel or MIUWU, although overhead video was provided by the unmanned air vehicle (UAV) and video equipped P-3 to provide input to the Full Dimension Protection (FDP) cell as part of the JTF COP. C2 of asymmetric surface engagements from the FDP cell was not possible through the C2 architecture linking FDP, MIUWU and PSU's. Instead, jet-ski threats were identified visually by HVU, MIUWU and PSU's at approximately one mile from the HVU. Since no neutral screening was used to create a classification problem, it was easy to declare and track the jet-ski attackers during six attack runs.

Measure 2: Time to initiate coordinated response to threat (including possible WMD) after detection, engagement or discovery of a planted device.

Under the conditions of this experiment, time to initiate coordinated responses to potential threats after threat detection was instantaneous. As already noted, lack of interspersed non-threats provided a situation in which identification by PSU's was not a variable. The PSUs took appropriate action to positioning themselves in response to the threat, without MIUWU coordination or vectors. It is assumed here that classification using other sensors (e.g., UAV) would have presented a different experimental condition and a separate C2 problem.

Measure 3: Perception of false alarms, fratricide and collateral damage risks.
As noted with the small boat attacks, lack of neutral traffic prevented assessment of false classification. It is assumed that fratricide and collateral damage would have occurred, resulting from small arms fire from the HVU and defending PSUs. Collateral damage to neutral units would likely have occurred as PSUs fired upon the extremely maneuverable and fast jet skis moving through neutral water traffic and between the PSU's.

OPFOR jet skiers claimed to have reached the HVU on all attack runs. OPFOR commentary noted PSU difficulty in maintaining a tight defensive zone around the HVU. However, PSU crews believed none of the OPFOR attackers were successful on any attack run. Under ideal weather and daytime conditions, PSU crews observed that jet-skis were easily neutralized by PSU and HVU gunners before attackers could get close enough to the HVU to be effective.

In other debriefed observations, MIUWU radar equipment was not effective in vectoring PSUs to threats. PSU coxswains commented that MIUWU did not coordinate their responses. All OPFOR attackers were tracked by Blue Force lookouts. Lack of coordination may have been the result of some PSU communication problems. Some observers noted instances in which PSUs could not talk between each other or with the MIUWU. However, these radio problems did not likely inhibit the ability of PSU's to respond to OPFOR threats. PSUs with communications to the MIUWU relayed information with hand held radios to PSUs lacking communications. In lieu of this level of C2, PSU's responded without further coordination or guidance. Boat coxswains did note that radios equipped with headsets would have greatly improved their ability to copy C2 nets, especially during high-speed maneuvering.

An additional JTF asset, USGC LONG ISLAND, could easily identify and track jet-skis. However, the cutter was assigned a sector close to the HVU, and could not engage the threats. Reconstruction of the situation will likely show that this vessel needed to be in a picket positioned at least one nautical mile from the HVU in order to react. From this position the picket vessel would need to close with the HVU and shoulder/walk out the OPFOR units, peeling of from the threat as necessary to allow PSU's to engage the threat and limit fratricide.

Hypothesis 5: Networked multi-sensor surveillance and response forces in layered defense can counter attacks from rubber rafts attack at night.

Measure 1: Ranges at which attacks are detected and at which they are declared threats.

Two PSUs were assigned to guard an anchored HVU, and two PSUs were assigned to defend the berthed HVU. OPFOR attacks were carried out only against the anchored HVU. PSUs executed figure eight patrol patterns for and aft of HVU and personnel used night vision sensors to detect and declare OPFOR threat 200-250 yard from the HVU. OPFOR units used shoreline cover for attack runs, advancing together and sliding off when spotted by PSU's. Some attackers were successful in reaching the HVU. The PSU's used spotlights to simulate their weapons on target, probably destroying one craft and damaging another. OPFOR commented afterwards that they gained the HVU as PSU's were focused on the center of the bay, and that the HVU did not appear to have adequate lookouts.

Measure 2: Time to initiate coordinated response to threat (including possible WMD) after detection, engagement or discovery of a planted device.

PSUs appeared to react late to approaching OPFOR units, which successfully advanced to the HVU. PSU's intercepted OPFOR as they fled the HVU, the result of an LPOIC's decision (no direction was given by higher authority).

Measure 3: Perception of false alarms, fratricide and collateral damage risks.

Because the threat was not noted until engaged at the HVU, no false alarms were made. Because the PSUs and OPFOR were operating without lights, it was difficult to distinguish friend from foe. A high fratricide rate may be expected in this environment.

Under the cover of darkness, it was easy for OPFOR to make it to the HVU. More than two PSUs were needed to guard the HVU at night. More lookouts equipped with night vision gear on the HVU, and PSU crews similarly equipped would have improved the probability of threat detection. Although radio communications were improved for this event, as mentioned earlier, headsets would further improve the Coxswain's ability to talk on the radios, particularly during high-speed maneuvers. Debriefing of PSU crews indicates that the MIUWU was not effective in vectoring the PSU's in this environment.

Hypothesis 6: Networked multi-sensor surveillance and advanced detection and management systems can mitigate effects of asymmetric WMD attack from low slow-flying aircraft.

Measure 1: Ranges at which attack is detected and at which it is declared a threat.

Measure 2: Time to issue WMD warning.

Measure 3: Time to initiate coordinated response to threat (including possible WMD) after detection, engagement or discovery of a planted device.

Measure 1-3 Observation: Due to the proximity of a congested public wharf area near the HVU, no small arm weapons were allowed topside per the promulgated Force Protection Plan. Ship's force could make visual threat designations of the LSF, and along with the small arms complement aboard the HVU presumably make a defense (capability of the ship to respond could not be observed however). Close In Weapons System (CIWS) trained in bearing and commanded to fire for effect is another possibility. Closest point of approach to the anchored HVU was approximately 500 yards, well within range of the ship's port and starboard 25mm Chain Guns (although not permanently mounted, would likely be available in this environment). For future modeling and simulation purposes, the hypothesis has yet to be adequately tested. In addition, this experiment included the Full Dimension Protection cell and WMD plume prediction models for assessment and coordination with civil-military planners in the event of chemical or biological release over the HVU in the vicinity of the harbor, or over areas included in the Defended Asset List (DAL).

Hypothesis 7: Networked multi-sensor surveillance and response forces in layered defense can counter night attacks against an HVU by anti-ship missiles launched from a truck ashore (when the threat is known to exist and within a specific area, proceeding to a possible launch area in the hills above harbor.

Measure 1: Percentage of times exit into or out of the area is detected.

Measure 2: Percentage of time truck is detected in logical launch position or condition before simulated launch.

This event combined concepts of Asymmetric Dominance and Full Dimension Protection. The addition of the Unmanned Air Vehicle (UAV) was particularly noteworthy in this experiment. Results are described further in the next section of Theater Air and Missile Defense (TAMD) in the asymmetric environment.

Hypothesis 8: Intelligence Preparation of the Battlespace (IPB), advanced sensors and networked control of the PSU by the MIUWU will allow more effective positioning and employment of the PSU against the variety of asymmetric threats.

Measure 1: Ratio of time to reset protective grid using MIUWU control to reset time without MIUWU control.

Measure 2: Ratio of detection by IPB to that without IPB.

Measure 1 and 2 Observations: In general, MIUWU reported good capability to detect all attacking and friendly units. MIUWU exercised control of engagements through C2 architecture in which communications were made from the TAO to direct PSU movements. As previously noted, there is disagreement between PSU's perspective and the TAO with regard to the receipt and effectiveness of the TAO direction. The MIUWU observer noted continuous message traffic from the TAO during these attacks. However, PSU's reported virtually no "helpful" communications from the MIUWU during attacks, and limited pre-attack warnings. Communications difficulties were addressed earlier. In spite of C2 concerns and disagreements with regard to effectiveness, the hypothesis was tested and it is clear that IPB does enhance effective employment of layered defense assets. As will be discussed later, tracking the truck/missile would have been very difficult without IPB.

SUBMITTED REPORTS

Naval Surface Warfare Center, Crane Division Report

Introduction

Population models estimate that 70% of the world's population will live in cities by the year 2025 and that 70% of these cities will be located on the world's littoral. Operations in these areas will be characterized by the application of Operational Maneuver From The Sea (OMFTS). Utilizing the sea as maneuver space, naval expeditionary forces must be prepared to execute a variety of operations without dependence on facilities ashore.

To support the Operational Maneuver From The Sea (OMFTS) concept, the Navy must have the ability to bring Marines into an urban littoral environment and remain on station to provide sea based C2, logistics and force protection. If the Navy intends to support the OMFTS concept, then techniques, tactics and technologies must be employed or developed to allow the Navy to operate for extended periods in the littoral regions and neutralize the various threats involved. This includes the neutralization of asymmetrical threats in the littoral.

The Asymmetric Threat portion of the Fleet Battle Experiment Echo was designed to test the hypothesis that " A maneuverable naval force protection capability – with access to theater and national sensors and control of response forces – can counter asymmetric threats to High Value Assets (HVAs) maneuvering in the littoral." Six experiments were designed to explore this hypothesis. Included in the 6 experiments were eight independent hypotheses, used to evaluate the respective experiments. Each of these hypotheses and the results are discussed herein.

Combat Swimmers

The first experiment involved three different combat swimmer approach techniques: surface, open circuit SCUBA, and closed circuit SCUBA. Two hypotheses were used to evaluate this experiment. The first hypothesis for this experiment was ... " Combat swimmers can be detected by the Mobile Inshore Undersea Warfare Unit (MIUW) and countered by coordinated operations of Port Security Units (PSUs) ". The defense against the combat swimmers was to consist of the MIUW unit embarked aboard the SLICE boat, PSUs under operational control of the MIUW and the watchstanders aboard the HVU. Measures of effectiveness for this event were the number of detections and the response times. This hypothesis was not fully tested. The AN/WQX-2 swimmer detection sonar device, which was to be towed by the SLICE boat, was not available, therefore no swimmer teams were detected by the MIUW. HVU participation was not noted by the swimmers, other than some additional lookouts at the pier area. Although no detections were made, the MIUW unit scripted some detections and vectored PSUs to various areas to simulate concussion grenade attacks. There was no determination made as to the timeliness or accuracy of these simulated attacks. This event was executed on three different nights during the experiment and the combat swimmers were able to penetrate the defenses and plant mines all three times. The HVA was a much easier target at the pier than at anchorage.

The second hypothesis for this event was " Attached mines can be located more quickly using hand held sonar units". Measures of effectiveness were the time to locate mines with and without the sonar device and the usability of the device. This hypothesis was also not fully tested. The hand held devices were not available for the experiment. The mine removal without the devices was interrupted due to safety concerns. The currents were stronger than anticipated during the scheduled removal time and visibility limited to about 4 inches. The mine removal was attempted again the next morning but again was hampered by strong currents and poor visibility.

This type of threat ranges from a very low tech, inexpensive, low level of training approach to a very high tech, trained professional combat swimmer. These types of evaluations should be used in conjunction with modeling and simulation. Many of the defensive measures that would be used to interdict combat swimmers are designed to slow them down, tire them out, and cause them to use up their oxygen supply. Most are too hazardous to use during this type of experiment and should therefore be modeled. Interception of the actual swimmers by small boats at night creates a potentially unsafe situation. However, before this event could be modeled, the capabilities of the swimmer detection sonar would need to be well understood. This would be accomplished by experimentation such as was planned for this event.

High Speed Boat Attacks

The hypothesis for high-speed boat attacks is "Networked multi-sensor surveillance and response forces in layered defense can counter small boat attacks". This event was simulated twice, once with the HVA at the pier and once with the HVA at anchorage with several runs made during each event. Due to the way the experiment was executed, a true test of this hypothesis was not possible.

One measure of effectiveness for this event was the ranges at which surveillance assets were able to detect and track the OPFOR boats. In the design of this experiment, the intent was the inclusion of neutral shipping to provide cover for the non-distinct OPFOR boats. The rules of engagement were such that the PSUs were to enforce a 1500-yard no transit parameter around the HVA and prosecute any unit entering a 500-yard engagement zone around the HVA. Surveillance assets were to be employed to detect and track the OPFOR boats as they left their staging areas and provide intel to the MIUW unit so that a prepared, organized defense could be established by pre-positioning the PSUs. This event was executed without benefit of the neutral shipping or the non-distinct OPFOR boats. The Coast Guard kept the test area clear of neutral shipping for safety reasons and the Special Boat Unit (SBU) was required to use easily identifiable, military boats. In addition, many of the surveillance assets assigned to spot and track the OPFOR were not available. Therefore the OPFOR was easily spotted visually and identified as hostile from a mile or more. This measure of effectiveness is therefore not valid in the context of this experiment.

There was some disagreement on the command and control effects of the MIUW unit for the blue forces. Observers on the SLICE boat, and on some of the PSUs, reported that the defense was coordinated from the MIUW unit, while some of the PSUs reported that they were not provided with any guidance. This situation was attributed to comms problems observed with the MIUW unit at several times during the experiments. One aspect that should be addressed is the communications gear aboard the PSUs. The units require the coxswain to key a hand mike to communicate. A headset maybe more appropriate as the coxswain requires both hands to maneuver the craft against high speed targets. One observer should also be provided with a head set so that he can hear what actually is communicated to the other assets. There was also disagreement on the success of the PSUs to protect the HVA. The PSU crews felt they were very effective, as did the OPFOR crews. Observers had trouble evaluating the outcomes for two reasons. First the PSUs and OPFOR boats were very similar if not identical and as the eight identical small craft maneuvered at high speed, it became easy to confuse the two. Also, OPFOR boats that may have been disabled due to effective PSU fire, kept boring into the target thereby hampering efforts of the PSUs to engage additional targets. Computer analysis will be performed to better assess casualties. The blue forces felt that the Coast Guard cutter was a very effective deterrent to the attackers while the OPFOR expressed an opposite opinion. The observers felt that the PSU tactics appeared to be fairly effective for the conditions evaluated.

A second measure of effectiveness for this hypothesis was "the time to initiate response to potential WMD threats". In the experiment scenario, one of the OPFOR boats is disabled and discovered to have a potential WMD aboard. EOD headquarters was notified and sent a response team to investigate. Reachback to a WMD cell aboard Coronado and national assets were evaluated. EOD responded correctly and professionally but untimely due to various communications problems. EOD headquarters was placed behind a building with a two story metal fence under the Bay Bridge, which contributed to the difficulties. In summary, EOD planned and executed their tasking as well as possible under the circumstances. Poor communications with the WMD cell aboard the Coronado and satellite unavailability combined to hamper a planned tactical response system that potentially is an excellent real-time tactical tool.

The last measure of effectiveness was the " Perception of false alarms, fratricide or collateral damage risks". False alarms were not evaluated due to the nature of the way the experiment was executed. The potential of fratricide and/or collateral damage at a pier side area or anchorage in a crowded harbor would be a definite possibility. This will be modeled for further evaluation.

Jet Ski Attacks

This experiment was very similar to the high speed boat attacks. The hypothesis evaluated was that " networked, multi-sensor surveillance and response forces in layered defense can counter jet skis". Many of the same issues that hampered the evaluation of the small boat attack were present here. The PSUs were judged to be reasonably effective against jet skis identified at long range, in an uncluttered environment. Multi-sensor surveillance was not observed. One observation of note was that the Coast Guard zodiac craft appeared to be a better match in speed and maneuverability to the jet skis than did the PSU boats.

Combat Rubber Raiding Craft

Hypothesis five was "Layered defense can counter night attacks by covert rubber raft". There were two measures of effectiveness that were used to determine if networked multi-sensor surveillance and response forces in layered defense can counter attacks from rubber rafts at night.

The first measure of effectiveness was the range at which attacks are detected and declared threats. There were two PSUs assigned to guard the HVA at anchorage, and two assigned to guard to HVA at the pier. The PSUs executed figure eight patrol patterns for and aft of the HVA. Night vision glasses were used to detect and declare OPFOR threats that were 200 – 250 yards from the HVA. OPFOR units approached the HVA together along the shoreline for their attack and split off only when they were spotted by a PSU. The rafts appeared to have successfully made it to the HVA, although one PSU used their spotlight to simulate a weapon and would have most likely destroyed one raft and hit the other. OPFOR felt that they were successful for two reasons; the blue forces were focusing their attention to the middle of the bay, and the HVA lacked lookouts that could have spotted them. The HVA at anchorage was the only one that was attacked during this exercise. OPFOR did not attack the HVA at the pier.

The second measure of effectiveness for this exercise was perception of false alarms, fratricide, and collateral damage risks. There were no false alarms made however, fratricide was probable by the PSUs during interception of the OPFOR units near the HVA. The reason for this was that both the PSUs and OPFOR units were running without lights, and it was easy to misidentify friend from foe. There was no collateral damage because of the location of the interception but running lights or additional night vision glasses would have helped identify targets.

The hypothesis tested false during this exercise. Unless detected, the rubber combat rafts can penetrate the PSU defensive barrier. More consideration should be given to detection.

Low Slow Flyer

Hypothesis six was "Networked multi-sensor surveillance and advanced detection and management systems can mitigate effects of asymmetric WMD attack from low slow-flying aircraft". This hypothesis was to be tested based on three measures of effectiveness; the ranges at which attack is detected and declared a threat, time to issue WMD warning, and time to initiate coordinated response to potential WMD. These measures could not be adequately tested because of two conditions during this exercise.

The multi-sensor surveillance and advanced detection and management systems were attempting to recognize the normal air traffic pattern in the bay area, and detect the asymmetric WMD attack based on an abnormal path from a low slow flying aircraft. During this portion of the experiment there was some confusion due to a local commercial seaplane that was docked on the pier near the HVA. The commercial plane made random trips in and out of the bay area during the experiment, which made it difficult to detect the Low Slow Flying aircraft that was attacking.

In addition to the confusion due to the random local air traffic, there were no small arm weapons allowed topside while in the San Francisco Bay area, therefore the ship's force could only point at the Low Slow Flyer (LSF) to simulate the detection and the ships defense posture. Even if the Low Slow Flying threat could have been identified, it would have been difficult to determine whether or not it was engaged in sufficient time to protect the HVA.

Because of these two conditions, the data collectors who were aboard the PSU, SLICE boat, Coast Guard Cutter, and US Navy ships concurred that the measures of effectiveness were not fully tested due to the inability to detect the experimental, low slow flyer. This being the case it can be argued that this hypothesis was found to be false.

Truck Mounted Anti-Ship Cruise Missile Threat

Hypothesis seven was "recon/surveillance can help track truck threats". During the testing of this hypothesis a truck carrying a cruise missile was detected and tracked by an unmanned aerial vehicle (UAV). This event was repeated twice in the asymmetric threat portion of the experiment. The UAV was cued to the time and location that the suspect trucks would be leaving a staging area. The UAV was to perform surveillance on the trucks and provide a video feed to the MIUW unit. This hypothesis was found to be true. One item of note was that there was a black "x" on top of the trucks for identification. Future experiments may try vehicles of a more covert nature. Some evasive maneuvering by the trucks may also be appropriate although the drivers commented that they never had any indication that the UAV was following them.

Intelligence Preparation of the Battlespace

There were two measures of effectiveness that were used to test this hypothesis. The first measure was the ratio of time to reset the protective grid using MIUW control as opposed to time reset without MIUW control. In general, the MIUW reported timely detection of all attacking and friendly units. However, from the PSU perspective the receipt and effectiveness of the commands that were issued from the MIUW unit TAO were not helpful. The PSUs reported that the communications during attacks were very poor and there were limited pre-attack warnings. Communications between the PSU's and the MIUW unit TAO were a major problem during the experiment even to the point where the drivers made inquiries as to whether there was jamming taking place by OPFOR. Providing the PSU coxswains with headsets for two-way communication during high-speed maneuvers would improve communications. In many cases, communications were impractical because the coxswain and crew were unable to operate the hand-held units during high-speed maneuvers.

The second measure of effectiveness was the ratio of detections with IPB to that without IPB. PSU drivers reported that they were reacting to threats as they identified them and then executed their pre-planned tactics. From the perspective of the data collectors and PSU crews, the attacks were detected and engaged much more efficiently by each individual unit. This was due to being able to identify the OPFOR as hostile at long ranges due to their distinctive craft.

Although there were problems with communications and discrepancies in reports, this hypothesis was tested. It is clear the IPB does allow for more effective employment of layered defense assets. It was not clear that the hypothesis was tested in the intended manner. Several air surveillance assets that were included in the planning sessions were not available during the events. Also, surveillance was much easier due to the lack of other traffic in the harbor.

NETCENTRIC ANTISUBMARINE WARFARE (NCASW)

MAJOR POINTS

- NCASW increased force situational awareness through distributed advance search plans

- Reliable networked communications are essential for Distributed Collaborative planning (DCP) in NCASW

- Common tactical decision aids and common understanding of the DCP process are enhance the update of situational awareness required for NCASW

CONCEPT

Mission Concept: Maritime dominance relies on the traditional air, surface and subsurface superiority in the battlespace.

Operations Methods: The employment of Network Centric ASW (NCASW) will improve the commanders ability to assess balance mission objectives with the risk imposed by adversary submarines.

System Solutions: Distributed Collaborative area search planning JEZ/JAZ

Technical Solutions: WeCAN, IMAT, SPPEDS

SUMMARY

The objective of network centric undersea warfare is to create a fully integrated undersea warfare capability contributing to full dimensional protection for forces in and beyond the Joint Area of

Operations (JOA). In FBE-Echo network-centric anti-submarine warfare the goal was to use distributed collaborative planning (DCP) for multi-sensor search and prosecution. An ASW cell with improved connectivity, standardized models and databases was stood-up for training and contingency operation planning in FBE-E and conducted both planning and execution during the associated Limited Objective Experiment (LOE). This was the first FBE in which undersea warfare played a major role.

Concepts being tested in the undersea warfare cell involved the availability of enhanced C4I systems to provide high data rate connectivity, fusion of a detailed underwater picture with surface and air pictures, use of search planning and assessment tools, battle management tools, and remote sensor management tools. Sensor systems providing passive acoustic, mono-static active acoustic, multi-static active acoustic, non-acoustic detection plus environmental characterization were required to complete the undersea picture. Finally, weapon systems for shallow water ASW, for loitering and in support of distributed sensors, mine neutralization, and non-lethal options are necessary in this asymmetric environment.

For FBE-E not all of these capabilities were present, but were simulated by the ASW anchor desk as necessary to conduct the experiment. The anchor desk was designed around enhanced connectivity to ships, submarines, aircraft, national assets, environmental information resources, sensor platforms and other command centers. Search plans from the anchor desk were distributed to affected units updated with local environmental information, assessment of compatibility with other assigned warfare duties and assessment of risk to that unit.

The ASW portion of the Anchor Desk was tasked to: Develop and evaluate search plan options to support the overarching campaign missions. Develop, maintain and distribute adversary submarine threat data and cueing information derived from all surveillance systems. Fuse, maintain and distribute coherent tactical and operational pictures of the undersea battlespace. Evaluate the effectiveness of completed search operations leading to an assessment of the current asymmetric submarine threat to the overarching campaign missions. Consolidate and analyze in-situ environmental data collected by dispersed sensor platforms. Cache and distribute oceanographic and meteorological data, imagery, etc., to provide "one stop shopping" reach-back service to assigned/supported ASW forces. Manage the collaborative search planning process and the employment of remote sensor systems. Conduct "what if" analysis of ASW search and force employment plans to evaluate alternative courses of action.

MEASURES AND OBSERVATIONS

Hypotheses:

During Phase I of FBE-Echo, the ASW Anchor Desk focused specifically on the search planning process. The first two hypotheses address the planning development cycle and measures that might be used to assess this process. The last four hypotheses were concerned with a Limited Objective Experiment (LOE), which took place in Phase II of FBE-Echo. The LOE was intended to experiment with new technologies including the Advanced Deployable System (ADS) and the Acoustic Communications System (ACOMMS), and assess effectiveness of the collaboratively developed search plan.

Hypothesis 1: A collaboratively developed and maintained area ASW search plan improves the integrated search effectiveness over an area of interest for a given set of sensors.

Hypothesis 2: The use of identical, high fidelity models and associated databases by all participants in ASW operations improves understanding of both the coordinated multi-sensor search plan and individual sensor performance. Additionally, the use of a common model allows "drill-down" into the factors affecting performance.

Hypothesis 3: Time integration of the tactical undersea picture provides additional significant information for all ASW echelons compared to the current real-time tactical picture alone.

Hypothesis 4: The undersea tactical picture provides sufficiently timely positional and operational information concerning blue force submarines to safely enable dynamic weapons exclusion zones around blue force submarines.

Hypothesis 5: An ASW Joint Engagement Zone (JEZ) will allow more successful prosecution of an adversary submarine than the current exclusive waterspace management policy protecting blue force submarines. (Note: The JEZ assumes a common tactical picture containing timely track information for blue force submarines and reliable, real-time communications between blue force submarines and the rest of the ASW forces.)

Development of a search plan was the only deliverable for the ASW Cell during Phase I of the experiment and therefore only a qualitative assessment of the search plan process could be made. Effectiveness of the search planning process to construct a viable search plan as a measure of system performance could not be determined until the following phase of the experiment and execution of the LOE. To facilitate this qualitative assessment, logs were kept by several members of the cell, including the IJWA (NPS student) observer, a Maritime Battle Center observer, and 3rd Fleet staff. Additionally, questionnaires were distributed to each member of the cell to collect qualitative input.
Preliminary results indicate that the first two hypotheses were substantiated in Echo and that the LOE provided additional substantiation to these hypotheses. Major points are discussed below.

ASW DCP: Distributed Collaborative Planning (DCP) methods were demonstrated to be essential overcoming the inherent complexity of area ASW. Common understanding of the planning process, assumptions, databases and limitations are critical to a cohesively developed search plan. Collaborative aspects of Phase I were done at a single location, with verification of distributed results tested in the LOE

TDAs: Real-time, adaptive planning becomes a tactical tool when performed to assess many "what if" iterations inside the tactical time constant. Each node in the network must employ common TDAs and effective methods to transfer information. The PC-based Interactive Multi-Sensor Trainer (IMAT) was demonstrated to be a key tool in building common databases. More TDAs need to incorporate range-dependent models as opposed to the range-independent models originally chosen because of lack of computer power at sea.

Information Compression/Processing: The volume of information necessary to support ASW search planning may be passed through low bandwidth by distilling all of the model input data to a small "kernel" that is shared among the participants. The processing power of the common TDA is then used to reproduce the full depth of the model results at each node. The use of processing power and identical tools at both ends of a communication line enables "information compression" vice simple data compression. This concept performed to the extent required to support Phase I, and was tested further in the LOE (analysis of these results are not yet available. From Phase I it is evident that the Web Centric ASW Network (WeCAN) SIPRNET-based web page provided a good, albeit high-bandwidth means to share information.

ASW Training: Force-wide ASW training supported a general understanding of relevant ASW factors and the information provided by the ASW TDA. Beyond this cursory assessment, it would be premature to make an assumption as to the viability of collaborative search planning in the ASW community. Comments received with regard to development of search plans were quite positive. The responses reflected a great deal of enthusiasm for the technology and an adaptive architecture that makes search plan development easier, more accurate, and more effective.

SUBMITTED INFORMATION

Precision Engagement

MAJOR POINTS

- Laws demonstrated flexibility and ease of use. While the system was by no means fully exploited, it performed well for the functions utilized during this experiment.

- Deconfliction requires further investigation. DAMS was not successfully electronically interfaced to LAWS. Full implementation of algorithmic procedural deconfliction in LAWS may yield improvement over current methods and be more efficient than DAMS. Any deconfliction system requires an adequate visualization tool to be useful. No methods currently address latency issues.

- Naval Surface Precision Fires weapons currently in use or programmed are not useful in the Urban Canyons.

- NCASW increased force situational awareness through distributed advance search plans

- Reliable networked communications are essential for Distributed Collaborative planning (DCP) in NCASW

- Common tactical decision aids and common understanding of the DCP process are enhance the update of situational awareness required for NCASW

CONCEPT

Mission Concept: Operate in the littoral, provide Naval Fire Support to place munitions on designated targets in a time constrained environment.

Operations Method: Employ sensor to shooter continuum versus fixed and mobile targets. Utilize Integration of imagery and targeting tools in support of reactive and deliberate targeting. Integrate the use of four dimensional near real time deconfliction in the execution of precision engagement. Conduct targeting and missile shots in a GPS jamming environment.

System Solutions: LAWS, DAMS, EFT, CCT, JSTARS, and ADSI

Technical Solutions: ISAR P-3 and Tactical UAV

SUMMARY

This pillar continues experimentation for the "Ring of Fire" which has been a strong portion of all of the FBEs to date and also of the related "Vicious Blaze" and "Silent Fury" efforts which address more deliberate targeting processes. Its objective is to utilize Naval Fires of all types to allow the operation of Naval forces in an urban environment where there is no organized conventional threat but a significant unconventional threat including terrorists and infiltration units including weapons of mass destruction.

The overall goals are to explore three aspects of Naval Fires (NF):

Targeting NF in an urban environment including integration of multiple imagery sources and targeting tools including the isolation of USMC areas of operations from enemy reinforcement.
Sensor to shooter capability against both fixed and mobile targets particularly use of UAVs in permissive and non-permissive environments.

Responsive deconfliction of Naval and other fires.

The desired effect of these capabilities was to suppress enemy activity levels to those that can be dealt with by the relevant in-country forces and to allow maneuver with minimal losses by friendly forces at sea, in landing or ashore. Secondarily, adaptability of personnel to the functionalities of the various systems and the potential automation of the processes is of interest. To accomplish these objectives, a network of ISR sensors and of command & control and weapon fire control systems was built using actual and simulated systems. The Land Attack Warfare System (LAWS) was the cornerstone of the network and was located in command centers on the Coronado and on the shooter ships as well. Major information flows were the UAV pictures, other imagery , the Common Operating Picture (COP) and target data packages from the various mission-planning systems.

1. National Assets, TACAIR and UAV Sensors for Fires in Support of Forces Ashore in Urban Environment

Based on actual and simulated cueing from HUMINT / national assets and Naval air platforms, plus the live UAV (the Pelican pseudo-Predator) tracking and spotting missions were performed. When appropriate, UAVs were tasked to locate, identify and track targets. Passing of specific threat information from the UAV control and fusion elements to the ashore units and shooters was evaluated. Integration of UAVs into overall surveillance planning was examined.

Initial Hypothesis: Navy UAVs in conjunction with other assets can provide effective warning and supporting fires for urban operations against the following threats:

Enemy actions beaches, streets / buildings - Monterey & SF
Enemy vehicular movements (Monterey to San Francisco)
Enemy infiltration in urban neighborhoods
Enemy WMD in industrial area
Night urban targeting
Vehicular target of interest

Interdiction of USMC operating areas
Fixed targets of WMD interest (Monterey and SF)
Actual range targets ñ TLAM & SLAM
Targets related to WMD vignette

Each of these activities generated real or simulated fire mission requests. Air and NSFS systems were tasked to support the missions. A deliberate (6 ñ48 hour) targeting exercise (Vicious Blaze) examined all-source imagery fusion, manipulation and dissemination for production of electronic target folders afloat. Silent Fury processes were planned on reactive targeting via TACRECCE for response under two hours.

Measures for this initial hypothesis are given below:

Measure 1: Responsiveness of targeting to mission requests: time to detect target and pass to shooters.

Measure 2: Ability to derive accurate target coordinates for point precision database within engagement time windows.

Measure 3: Ability to build electronic target folders for major targets of interest including WMD-associated targets within time windows of opportunity.

Implementation: For Measure 1: Flew simulated A/C and national sensors to cue UAV operators to locate, identify and track hostile targets. Used simulation to maintain ground truth and support surveillance planning. Compared simulated results to real views for detectability. Consolidated and recorded timelines with LAWS for analysis. Maintained electronic logs of major results of flights and simulations. Provided a questionnaire to gain insights into difficulties of control of UAV operations and passing of information to affected units. For Measures 2&3 observers recorded processes used to obtain and manipulate information into target folders for evaluation by the shooters. Usability of the systems was assessed by a five-point subjective scoring of the features.

As anticipated, the range of target conditions above strained the capabilities to quickly respond with effective strikes.

The Precision Engagement portion of the exercise consisted of experimenting in how the Navy will support ground operations ashore with Naval Fires. This included new technology and new tactics, techniques and procedures. The three cells primarily involved with this evaluation were the Joint Strike Center (JSC), the USMC Enhanced Combat Operations Center (ECOC) and the Joint Fires Cell (JFC). The Joint Strike Center was primarily concerned with deliberate targeting at the strategic and operational levels. They used various sensing assets to collect imagery on potential targets for strike planning and the building of Electronic Target Folders (ETFs). The Enhanced Combat Operations Center was primarily concerned with reactive targeting to support ground forces ashore at the tactical level. Sensing assets were also used at this level to refine the target location, status and type. These two cells fed fire mission requests to the Joint Fires Cell via the Land Attack Weapons System (LAWS). This system allowed the JSC and ECOC to rapidly and efficiently pass fire mission request via a Local Area Network with a high degree of accuracy. This information was evaluated in the JFC to ensure it met Commander's Guidance and then a shooter was assigned to fire the mission. The mission information was transmitted via

EHF satellite to a LAWS workstation on the shooter. LAWS was able to keep track of all pertinent data on the target, the units ashore and the fire support ships available so the decision-maker's situational awareness remained very high.

This hypothesis was partially maintained. The Predator sensor package in the manned Pelican vehicle proved invaluable in the urban environment. IR imagery did very little for the LAWS director. In comparison, JSTARS provided operationally substantial information in the urban environment but high traffic density made it difficult to distinguish contacts of interest. Sensor control is enhanced by bringing it close to the tactical center of gravity but integration across platforms is still difficult when choices between situational awareness and target prosecution must be made. Naval surface precision fires were rarely used as the weapon of choice in a city. A different weapons mix must found.

Sometimes FYI free text messages were interpreted as possible calls for fire. This can be worked out by establishing the fire support language to be used. The LAWS director did not fire the missions but had to waste time asking for clarification.

There was confusion over how many people and who had authorization to actually approve a fire mission. Everyone agreed this was because of the lack of understanding of what C2 relationships were and how information was supposed to flow.

There has never been a fire support overlay developed for any of the missions. This document should lay down basic fire support coordination measures.

In summary, while LAWS itself is a capable system, there exists a huge gap in what it can do and how we can exploit it with current tactics, techniques and procedures. Everything from TTPs to shipboard organization to comm links to mindsets needs to be changed to accommodate such a highly automated system. However if these can be changed very accurate, reliable, lethal fires could be delivered to battlefield while optimizing airspace via deconfliction.

Deconfliction

The use of long-range Naval weapons in these circumstances is currently constrained by the inability to efficiently deconflict the flight paths and trajectories and weapon effects of aircraft, UAVs and weapons. A more dynamic approach to deconflict could allow more efficient use of forces and more rapid striking of targets while avoiding fratricide. The deconfliction approaches can vary from decentralizes dynamic "get out of the way" to very centralized "permission granting systems. FBE-Echo will look at 4D (latitude, longitude, altitude and time) with a bubble of airspace around each object to minimize the amount of airspace closed to other weapons systems.

The Precision Engagement portion of the experiment also looked at how the myriad of missiles, unmanned aerial vehicles (UAVs), aircraft and shells can be orchestrated to minimize the risk of fratricide while optimizing the use of heavily used airspace. The Dynamic Allocation Management System (DAMS) was linked to LAWS to provide rapid airspace deconfliction for incoming shells and missiles and aircraft transiting the area of operations.

Hypothesis: Dynamic deconfliction techniques can provide control in limited but diverse operations.

Measure 1: Targets served per period.

Measure 2: Time ñsensitive targets served while in engagement window.

Measure 3: Time for dynamic deconfliction vice permission with normal TTP.

Measure 4: % of battlespace available for dynamic assignment of fires.

Implementation: The Dynamic Airspace Management Systems (DAMS) was used to predict trajectories and summarize status for time periods. DAMS was to be the major data source as well as the source for target requests and missions planned in LAWS.

The experiment was essentially a 'no-test" regarding this hypothesis.

There was some basic deconfliction between missions the JFC was firing and the P-3 and UAV were sensing. However, this was just because we could read their position data off the imagery. If it had been an actual military airspace it would have been significantly more cluttered. DAMS integration did not happen.

An automated deconfliction tool with visual display would provide the quick verification that appears to be desired.

Dynamic deconfliction is a long-term solution with significant potential but is a long way from implementation.

MEASURES AND OBSERVATIONS

Hypothesis: Current weapons system targeting processes are disjointed and do not exploit available technologies. Precision engagement is a resource-demanding endeavor that sacrifices execution speed for accuracy. FBE-E will experiment with new technology and supporting tactics, techniques, and procedures (TTP) with the intent of improving integration among weapon systems and between operations and intelligence efforts. Such activity will result in improved speed and accuracy of the targeting, planning, and execution processes, and reduce requirements for restrikes. Airspace deconfliction resulting from flight path conflicts, weapon trajectories, weapons effects, friendly aircraft, and unmanned aerial vehicle (UAV) flight are also problems that constrain the use of long-range weapons. Improved technology and new ttp explored in FBE-E may allow inefficient airspace procedures to be amended for greater weapons effectiveness.

SUBMITTED INFORMATION

FULL DIMENSION PROTECTION (FDP): JOINT THEATRE AIR AND MISSILE DEFENSE (JTAMD)

Major Points

- Full Dimension Protection, as a concept operationalized through an FDP cell coordinated with a Harbor Defense Coordinator aboard an afloat MIUWU, and supported with a range of technologies, tactics and C2, successfully provided enhanced force protection in an asymmetric littoral environment against a range of threats.

- LINEBACKER concept proved its capability to provide JTAMD in concert with AADC role. Multiple constructed targets were successfully engaged, coordinated with the FDP cell and in an environment in which consequence management took on considerably greater importance due to presence of WMD. Excessive switching in and out of LINEBACKER/Tactical mode did present some hardware problems however, an area of further investigation.

- Synergy was demonstrated between technologies available to the FDP Watch Captain, and essentially proved the value of a network-centric environment in maintaining and using a Common Operational Picture (COP). Specifically, combining near real time information of JSTARS, ADSI, UAV real time video feed, and targeting tools in LAWS created a responsive system in the FDP cell of immense variety. This variety was critical to the JTF capability to mount effective coordinated response, in a "Ring of Fire."

- Distributed Collaborative Planning (DCP) enhanced situational awareness between FDP cell on USS CORONADO, USS PORT ROYAL (AADC and LINEBACKER) and provided a reach-back capability to SMDBL and MOSC (Naval Postgraduate School also maintained a parallel COMPASS session during the experiment) that was essential in operational planning. COMPASS, as the DCP provider in the experiment was used daily as a means of coordinating planning. More importantly however, it was used effectively to establish a Defended Asset List (DAL) between the JTF provider of forces, and civil-military authorities. Construction of the DAL and the ability to engage in reevaluation in a dynamic environment was critical to defining force placements and real-time planning. Additional definition of DCP tools and protocols for their use and bandwidth to support them are areas requiring further consideration for additional experimentation.

- Joint coordination with AVENGER units added SHORAD to force protection. Combining within the network-centric environment in the JTF needs further development, in particular when combined with JTAMD and LINEBACKER. Coordination was developed through the course of the experiment, rather than prior understanding of interfaces and responsibilities.

- UAV added a superb capability to the FDP cell. Video feed directly to the watch team could be cognitively combined with additional information, e.g., ADSI fused LINK COP, surface picture from the HDC to the FDP and other technical sources to provide exceptional SA. This was proved to be particularly effective in FDP mission to find the WMD carrying vans, then respond to a range of potential developments. The UAV video feed included GPS data and cross-hair ranges that enabled the FDP cell to provide targeting information to JTF assets.

In the final event, the FDP Watch Captain was able to engage the WMD vans using naval gunfire, based on UAV provided information. UAV operations need further refinement however, in the areas of C2 and command relationships. The platform was a demonstrated success, however the command relationships and C2 to support its use in a naval or joint operation and in a network-centric environment have not been developed. Tasking of the platform was often difficult and was a system with multiple internal conflicts.

- Low Slow Flyer (LSF) threat requires additional study. By chance, the HVU was pier-side next to a seaplane excursion operation. Multiple take-offs and landings by this aircraft made discriminating and reporting an actual LSF threat very difficult. The experiment was to include feed from the Western Area Defense Sector (WADS) radar, which was to be observed over a period of days to establish patterning behaviors for civilian aircraft. This feed was not available until the last day of the experiment however, and it is not clear that such patterning would have provided significant discrimination for evaluation. Another tactic was enacted by the FDP cell in lieu of WAS feed; CAST was used to determine most likely sites for LSF operation. JTF assets were then used to gather specific intelligence with regard to operations in these areas, which did in fact yield the OPFOR threat aircraft. Additional research needs to be conducted with regard to LSF threat and engagement, especially with regard to potential WMD capabilities.

- Use of the Joint Interface Control Officer (JICO) concept greatly enhanced the usefulness and reliability of the TADIL COP. The multi-link van (MLV) employed LINK tools that facilitated interface and maintained LINK operations. This operation, together with the Air Defense System Integrator (ADSI) maintained on USS CORONADO provided a combined LINK-11 and LINK-16 COP. As mentioned above, this COP was combined by the FDPCC within the network-centric set of tools provided in the FDP cell to create a range of actions as the dynamics of the tactical situation changed. JICO employment needs further development to include within the organic capabilities of the JTF.
- Use of visualization tools, such as STALKER enabled the FDP watch to make nearly immediate assessments of cruise missile launch and impact points. Coordination of actions between JTAMD, WMD analysis of engagement (consequence management of potential plume dispersions) and CIVMIL authorities provided a powerful system for near real-time COA determination. Further work needs to be considered however, for best means to provide coupling between these processes and technologies with WMD data; plume analysis from HPAC as part of the COA analysis vice post impact/engagement consequence management.

- Coordination with Precision Engagement, Land Attack Warfare System (LAWS) emerged as the experiment progressed. A LAWS terminal was included as part of the FDP suite, and a member of the FDP watch organization worked with the Precision Engagement cell to produce a working FDP-LAWS-PE fires team which demonstrated its effectiveness at sensing, identifying, targeting and pairing in numerous events. This process greatly decreased the potential TCT timeline of some events.

- Command relationships between FDP, the JTFC and joint operations need to be further defined. In this experiment there was considerable ambiguity in the precise distinction of the command relationships implied by FDP centralized capabilities and roles. Two examples for further definition are the development of FDP as the JTF moves from blue-water (CWC tactical environment) to littorals (FDP tactical environment). Consequences for battle-group organization and joint forces C2 are highly interrelated in this concept.

CONCEPT

Mission Concept: If an expeditionary force is operating ashore, then the commander responsible for the defense of those forces should establish a Full Dimension Protection (FDP) cell to provide a single point for force defense.

Operations Methods: An FDP cell was formed under the CJTF and provided with technologies, procedures and personnel onboard USS CORONADO. A Joint Interface Control Officer (JICO) was assigned, with the objective to construct a defensive grid from TADIL data that would be observable at all levels between defense coordinators and expeditionary commanders. A C2 architecture was constructed that was to provide an analog of a network-centric environment in which all-source sensors and intelligence would be made accessible by CJTF and operational commanders to enable them to make tactical decisions in a time critical environment. An architecture was proposed in which civilian and military sensors would share data to construct a defensive grid, and was to include airport and harbor radar as part of the fused grid. A civil-military defense network was established to provide timely warning of asymmetric Ballistic Missile and air breathing threats capable of delivering a WMD.

Alongside the construction and implementation of various architectures, tactics, techniques and procedures (TTP's) were to be developed as an inductive process within the experiment. These included: the assessment of means to pattern civilian traffic patterns (space, air, land and sea) for discrimination of asymmetric threat against activity norms; use of LINEBACKER tactic to couple FDP to tracking of space and potential ballistic missile threats; TTP's for self-defense of high value assets (HVA) in confined battle-space; development of LINEBACKER TTP for defense of the CJTF DAL while simultaneously providing self-defense in an asymmetric environment; explore use of Naval control of Shipping (NCS) and MIUWU coordinated with civilian harbor defense authorities to deconflict surface engagements with asymmetric threats amongst civilian traffic.

System Solutions: <u>Technologies</u> (STALKER, EDGE, COMPASS, JSTARS, MSCT, LAWS, HPAC, ADSI, UAV), <u>organizational</u> (FDP cell, MIUWU-NCS, JICO, SHORAD-AVENGER, Precision Engagement, CIVMIL, WMD), <u>C2</u> (COMPASS, satellite, HF, UHF, VHF, land line, cellular comms, UNCLAS and classified web, GCCS/JMCIS), <u>data</u> (ADSI, JICO-TADIL), <u>TTP/tactical</u> (LINEBACKER, traffic patterning, NCS, UAV control).

SUMMARY

JTAMD has been an important concept in FBEs to date. In FBE-Echo JTAMD was expanded conceptually to include defense against asymmetric Low Slow Flying (LSF) aircraft, theatre ballistic missiles and cruise missiles. The addition of AEGIS SPY-1 in a "Linebacker" mode combined with new sensors and technologies was to be tested in this experiment. A specific objective of the experiment was to explore the ability of the Expeditionary Force to make use of in-place civilian sensors to help establish a defensive grid. These sensors included airport and harbor radar and the supporting civilian communications system. UAVs, national assets and appropriate military systems such as the Air Force's JSTARS and Army AVENGER air defense units were also used in the network centric sensor and defensive grid. Fusion and control occurred aboard the CORONADO and the SLICE-boat embarked MIUWU as the asymmetric threat response cell. A Directed Energy Weapon (DEW) was also simulated as part of a C2

experiment include new technologies and develop tactics, techniques and procedures (TTPs) for their use.

In addition to maintaining an air picture with diverse sensor sources inputting data to an active defense, JTAMD included planning of attack operations and simulated operations and coordination with launch platforms, C2 nodes, missile stocks and infrastructure. Special software to support planning was installed on CORONADO and integrated fire missions passed to the Land Attack Warfare System (LAWS), to control weapon-target matching and mission cueing.

Hypotheses related to JTAMD in general were concerned with use of sensors to construct a sensor grid that would be sensitive to a high variety of asymmetric, air breathing and missile threats. At the same time, FDP was meant to integrate new technologies and consequent high data rates to create an effective defense and provide a C2 structure for other warfighting areas. As a result, JTAMD as part of FDP crossed most other warfighting areas important to the JTF.

Hypothesis 1: Addition of information from indigenous military/civilian systems (e.g., airport radar) can significantly improve the fused picture of air and surface showing conventional and asymmetric threats. Initial measures considered for this hypothesis:

Measure 1: Range at which a low, slow-flying threat can be detected and tracked.

Measure 2: Range at which asymmetric surface threats can be detected.

Measure 3: Warning time of a missile launch or range at which asymmetric cruise missile can be detected and engaged.

Measure 4: Fraction of population in affected area warned of asymmetric threat or WMD release.

To a large extent this area concerns adding civilian air track information and sophisticated processing to the force protection picture being generated in the Asymmetric Dominance areas described earlier. Measures (1) and (2) occurred again against the same threats and are treated in more detail there. Measure (3) assumes a cruise missile threat similar to that described below as well but extends into the track and engage portions of the event. A modeled event derived from this portion of the experiment is being prepared from electronically recorded data aboard the TAMD ship, detailed in collaborative logs maintained in the FDP cell and fused data at the Air Defense System Integrator (ADSI). An engine for this model is being constructed around Naval Simulation System (NSS).

Measure 4 involved the participation of a civil-military cell aboard CORONADO with the FDP cell. Although the hypothesis could be tested with respect to passing warnings to civilian authorities, the process of bringing together sensors fused at the FDP cell and models to provide data on launch points, distribution of WMD products and impact points required a system assessment. A collaborative event log and recordings of individual events was maintained for this purpose. To a large extent the success of this area should be assessed at two levels. The first is the ability to provide connectivity to the potential sources of information in an interoperable manner (national and JTF sensors). At the next level is the added value of this information to that provided by organic assets. Because of the qualitative nature of value added, a questionnaire was administered by NPS students (brought aboard to capture data) to gather significant observations by participants after significant events.

The Air Defense System Integrator (ADSI) fused together all the tracks from the Link 11 and Link 16 tactical data links. This database was preserved for later analysis of specific events. For example, simulated missile tracks were injected from SPAWAR in San Diego, which were included in link data reported to the FDP cell via ADSI. These tracks became the basis of TAMD intercept problems, which included plume analysis and impact point analysis for delivery to the civil-military cell for further action. Further analysis of these track data is ongoing, using data reduction of the very dense Link reporting systems and positional data fed to NSS.

The hypothesis was partially confirmed in that the LINEBAKER multiple-AEGIS ship configuration allowed remote tracking, reporting and simulated engagement of simulated air/missile threats to the city. Combined with the fused link data, modeling technologies and C2 aboard the flagship, the JTAMD system improved situational awareness of such threats and allowed warning to be provided to civil defense authorities within one minute.

Army AVENGER air defense units were likewise able to provide direct support to ground elements while maintaining Link 16 connectivity, ensuring the same COP with Aegis units so that the JTAMD umbrella was stretched over the littoral. Additionally, participants noted that JSTARS data provided valuable tracking data on boats and vehicles in the city.

A Joint Interface Control Officer (JICO) function was established to maintain continuity of the joint data link picture to the COP. Some difficulties were recognized, as connectivity was tenuous and further investigation of sensor management/ integration is indicated. Because much of the link was maintained as a serial feed (phone line vice electromagnetic data feed), span of control was stretched without regard for realistic C3 difficulties so that FDP was not tested with regard to C3 capabilities.

Activities within the FDP cell focused on the actions of an FDP Cell Commander (FDPCC). Once MSEL events began, the FDPCC directed watch-standers to accomplish tasks necessary to complete the event. Two watch-standers, a Surface Defense Coordinator (SDC) and an Air Defense Coordinator (ADC) monitored the Surface and Air voice nets and controlled surface and air threat coordination while the FDPCC monitored the Command net and controlled JTF assets using technologies within the FDP cell. Other positions in the cell included contractors to operate and manage various contributing technologies: EDGE, ADSI, LAWS, STALKER and COMPASS.

The experiment demonstrated the fusion potential for the many sensors dedicated to FDP. Working relationships between technologies and their value added within the FDP cell was not well formulated prior to events. However, what was demonstrated was that centralization of many sensors, predictive and targeting tools placed in an operations room enhanced situational awareness of decision-makers and provided a common operational picture. Future experiments of this concept should be designed around more specifically focused hypotheses (or narrower concepts). TTPs constructed to improve independent system performance as part of the FDP decision making structure might also prove useful in determining useful and valid measures of effectiveness and performance.

As an example, an important FDP capability involved "patterning" civilian air traffic over a period of days to create a picture from which to later subtract anomalous behavior of what might be an asymmetric threat (low slow flyer). When Western Air Defense System (WADS) data was fused with the JTF Link (military air picture), there was a significant problem with clutter. Without clear TTPs to determine how this information could be processed and used to enhance the COP to provide value-added data, it was difficult for the watch team to use the information presented. In addition, measures of effectiveness were limited at this level to determining whether the data system supported construction of the picture, but not the effectiveness of system components. By conducting this first experiment however, it will be possible to construct measures of effectiveness and performance, and focus concepts to be tested in experimental design.

At the point in analysis of FDP and TAMD in FBE-Echo the data supports system level assessment. Reconstruction of individual events using modeling and simulation tools will reveal much about system interactions and provide additional insights. This event level analysis is being pursued at present.

SIGNIFICANT EVENTS AND RELATED COMMENTARY

(Extracts from logs and observations; local time stamp)

03140541: Status report. UAV flight 12 March, 1530-1700U. GBS problems precluded real-time receipt of video, but passage via VHS will allow later exploitation. JSTARS training in FDP cell continues. Integration of graphics feed (MTI and SAR) will not be possible on SIPRNET as the ground station's format is proprietary and not connected to SIPRNET backbone. Electronic Target Folder (EFT) 1 is posted on SIPRNET at C3F homepage. TASID is up and ready to pull UAV streaming video from PELICAN when GBS link is up. IPL status also prevents pull of national imagery, so training continues with file imagery.

C4I issues noted at the beginning of the experiment provides a snapshot of efforts (these were noted on 14 March). Internal red phones not operational (FDP cell), with contractors onboard to troubleshoot. GBS is partly installed and continues to be worked on. IPL is down but trouble-shooting is in progress. JSIPS-N has good comm path established but circuit connection is not stable to the EPS. IESS segment of JSIPS is down, trouble-shooting in progress. MDS 4.X is up but still not receiving threat data from GCCS-M. CCT lite is up but Net Meeting connection is intermittent due to CA III blind spot. JTW is up except Target Package Generator (TPG) program, with the contractor attempting a software fix. TASID nearly fully functional. GISRS common operational framework (COF) software is not running due to a bad power supply, ETR unknown.

03141000: Country Orange executed three test launches of SCUD missiles from the Hawthorne area at 1000U, 1005U and 1015U. Missiles were launched on an Easterly heading and landed in the Tonopah test range. Indications of launch received by USS PORT ROYAL through STRED. Launch message from USSPACECOM were received on GALE but were not received either through ADSI via Link 16 or JMCIS in the FDP cell. Coordination with CMOC and Medical cell confirmed SAT communications from FDP cell through CMOC to Governor's Office of Emergency Services via both voice and data.

Orange direction of fire was non-threatening, however if scuds are launched toward city all units in ATF are at risk. All units must be up FDP Command net (designated TA202R1). Specifically, CORONADO, BON HOMME RICHARD, PORT ROYAL and JOHN PAUL JONES have the capability to receive external data or track missiles. As ships enter harbor they become more vulnerable to asymmetric threat, I&W will be passed over FDP Command net. All units review FDP Plan (C3F DTG 131523ZMAR99).

During DCP session, AEGIS LINEBACKER radiation parameters determined from RP&C were discussed. PORT ROYAL was requested to send CAPS image including DAL and SM-2 BLKIVA coverage during the next DCP (COMPASS) session. Exchanged information with WMD cell to include translating their plume models for truck agent dispersal to moving air burst model to support civil-military warning over voice and data circuits.

JICO is coordinating LINK 16 connectivity for BON HOMME RICHARD, JOHN PAUL JONES and U.S. Army Avenger SHORAD unit.

03141532: LINK testing yields interesting results. JOHN PAUL JONES (JPJ) launched simulated ballistic missiles using the AEGIS dynamic test target program. These targets were broadcast over LINK-11. CORNOADO (CO), BON HOMME RICHARD (BHR), JPJ and PORT ROYAL (PRY) and the multi-LINK van were all up on LINK-11, however, the only platforms that can interpret the expanded M-7 message format are the two Aegis ships, JPJ and PRY (both are AEGIS 5.0). If CO had been upgraded to also receive and interpret the M-7 message format in LINK-11, this would have provided the FDP cell with the capability to have two means by which to receive space tracks, LINK-11 and LINK-16.

A significant lesson learned with regard to LAWS; It was discovered in the course of preparing ADSI for use on CO that LAN tracks can be presented on LAWS, which is installed in the FDP cell. This means that in the situation in which the FDP cell does not have voice communications, or in a time-sensitive targeting situation, a fire mission can be initiated by the FDP cell on a J-3.0 message by simply right-clicking on the mouse and scheduling the target.

SHORAD participation in the LINK is solid. Avenger unit is copying LINK-16 and therefore involved in the distributed defensive grid.

03141552: LAWS installation in the FDP cell is complete. FDP cell watch expects to be able to observe launch point information displayed on LAWS (passed from detection platform through LAWS). LAWS operator in the FDP cell will be able to conduct defense to offense target designation by scheduling all launch points received via J3.0 message as immediate targets for the Precision Engagement cell.

Comment: Significant finding for further time-sensitive targeting experiments.

03150831: Distributed Collaborative Planning (DCP) session with PRY. Defended Asset List has been expanded to include San Francisco Harbor, San Francisco Airport, the downtown district, Oakland, Sacramento and Marin County. The expectation, as an outcome of the DCP session, is that PRY must now plan defense with Avenger SHORAD and SMDBL, then request additional defense assets as required from the CJTF. Additional information is required regarding Avenger capabilities, and requested from SMDBL as part of the DCP session.

JICO is presently working an issue that concerns bringing JSTARS into the LINK. Also of concern is that the SLICE boat on which the MIUWU is riding, has no LINK capability.

Comment: Without LINK capability the MIUWU relied on voice communications between the naval control of shipping (NCS) officer in the FDP cell to direct MIUWU towards potential threat areas or in response to sensor indications of jet-ski, small boat or swimmer attack. MIUWU would then direct JTF assets in response. This situation added an increased C2 load onto the FDP cell, which had the impact of adding to the perception that C2 was not adequate to the conceptualized FDP role.

03151039: Orange launched two test missiles to intimidate Green. Three space systems detected the launches and reported them over STRED. Individual tracks were received for launch vehicles and impact points. The information was passed by the FDP Watch Commander to all units on the FDP Command net, and to the Civil-Military Operations Center (CMOC) for consequence management.

Impact prediction from SPACECOM produced an ellipse that showed probability of either a water or land impact, including populated areas just to the north of San Francisco. Based on this information the FDP cell initiated a weapons tight order, in spite of possible shore-impact.

Comment: FDP cell did not have track information from AEGIS platforms, nor was the launch event correlated through JMCIS (cause undetermined) which would have provided the additional resolution needed to make a more determined choice between destroying incoming missiles, or allowing them to land in the water.

As a second comment, tracks received from SPACECOM and injected to the COP through ADSI should be rebroadcast so that non-TRE or TRAP units can follow space-related predictions. JPJ did not receive these inputs, for example.

Third, in relation to this event, LAWS was not included in the launch-to-impact COP. In the course of the experiment it became obvious that the correlation of these events with LAWS capability could be immensely important to immediate CJTF response against launchers. This once again points to a relationship between FDP, LAWS, time-critical targeting and Precision Engagement that needs to be further explored. As a specific issue, tracks need to be displayed on LAWS from ADSI, however, track numbers on ADSI do not correlate to LAWS track numbers. This ambiguity makes the targeting problem very complex, requires manual correlation and increases time latency in time-critical targeting.

03151055: FDP DCP session. CMOC/city officials are offered Army Avenger unit to provide additional protection to downtown district of San Francisco. It is noted that Avenger is only capable of countering air-breathing threats (i.e., not against theater ballistic missiles).

Comment: FDP cell proposed a TTP in working with WMD/CMOC. Using a combination of ADSI and EDGE, the FDP cell provides an improved impact ellipse to CMOC, vice use of SURENET warnings (too slow). A macroscopic report of a 3-5 mile ellipse will be used by FDP as an input to EDGE, which will refine the probable area to a centroid on the order of a few yards.

03151405: FDP cell is receiving video feed from UAV and P-3 of the suspected WMD convoy (chemical weapons). A decision is pending within FDP as to whether the convoy should be struck, and the possibility of chemical weapons release. I&W indicates that the convoy is heading towards pier 35 and the vicinity of the CORONADO. JPJ and PRY indicate they are presently in LINEBACKER mode.

03151410: MIUWU reports that the UAV and P-3 have sighted two contacts moving to the vicinity of CORONADO.

Comment: An example of a shared COP, and coordination of information between these two geographically displaced centers.

0315151430: Fireball (TBM) alert is given over FDP command net. Received I&W from both TRAP and ADSI on JMCIS. JMCIS correlator was observed to operate correctly. Warnings were passed over the JMC net to city officials at 1432, with estimates of an impact area off of the city (no threat to coastal areas).

MIUWU simultaneously reports two surface contacts which may be carrying a WMD. WMD cell is alerted by FDP watch, but FDP cell is unable to maintain comms with the SLICE boat.

03151530: FDP and WMD cell met to develop consequence profiles of TBM intercepts at 40k, 60k, 80k and 100k feet. 60k intercepts were decided upon, based on models of plume migration. Projections and information are sent to PRY for inclusion in RP&C based decisions for maintaining threat areas. Optimum intercept requires that the missile be intercepted between 60 and 80k feet, with lowest lethality of CW. PRY is tasked to model and evaluate various launch and intercept profiles with these constraints.

03151555: MIUWU detaches small boat unit (SBU) craft from defense of CORONADO for refueling, which takes this defense away from the HVU (high value unit). At the same time, the MIUWU reports that it has sustained a casualty to its navigation system is unable to continue as HDC (Harbor Defense Commander) until the problem is fixed. JPJ is tasked as HDC from anchorage 7.

03151600: FDP cell contacts the MIUWU to report possible swimmer threat to HVU. MIUWU responds by tasking the Port Security Unit (PSU) to provide a layered defense posture around the HVU.

03160735: PRY reports that they will not be able to defend the expanded DAL without additional Avenger support. Treasure Island is discussed to provide staging area for AVENGER units.

Later in the same day PRY verified that it could cover all of the DAL except for the Sacramento area, and requested AVENGER support for this.

03160924: Vessel Traffic Information Service (VTIS) reports a small aircraft in vicinity of anchorage 7.

Issue: JMCISS does not allow simulated tracks to be merged with "real" tracks. This is an issue for further experimentation development.

Issue: Strictly an outcome of the architecture designed in the experiment; that the FDP watch officer does not have direct communications with the VTIS. Instead, communications are conducted with the Coast Guard Cutter.

03160940: PRY is directed to send CAPS information (overlays) during morning DCP session. Work continues with the AVENGER unit to find an authorized placement site for their mission.

Comment: Placement of AVENGER units is quite complex. Previous planning must be conducted with regard to their placement prior to mission definition. In other words, if littoral operations are anticipated in a specific geography and use of AVENGER is anticipated, sites for their placement should be defined in a pre-planning document.

03160951: CAST defined 70% probability that a TEL site is located at 39' 00' N and 118' 41 W; based on type of vehicles, possible hiding sites and information operations with regard to chemical supplies.

03161005: Beginning of multiple "FIREBALL" TBM launch reports via ELINT and SPY-1. Three missiles launched, with genesis and impact points reported.

03161007: Birds away against three TBM targets. Impact points reported to CMOC for consequence management.

Comment: One of the TBM targets is defined as unengageable

INFORMATION SUPERIORITY

MAJOR POINTS

See SPAWAR draft report in Appendix.

CONCEPT

Mission Concept: Provide sufficient and reliable networking of communication information in the battlespace.

Operations Method: Naval Forces operating in the littoral will have access to signals previously unavailable to afloat sensors. The ability to monitor and report levels of activity about communications paths will enable command action to restore or enable connectivity and flow of information.

System Solutions: Naval Communication Network

Technical Solutions: SNIFFER

SUMMARY

See SPAWAR draft report in appendix.

MEASURES AND OBSERVATIONS

No hypothesis or measures were developed prior to the experiment.

SUBMITTED INFORMATION

See SPAWAR draft report in Appendix.

CASUALTY MANAGEMENT AND CIVIL MILITARY OPERATIONS

MAJOR POINTS

- DARPA One Way Multi-Lingual Interview System shows promising utility.

- The Center of Excellence in Disaster Management and Humanitarian Assistance (COE) using proprietary software SoftRisk enabled interface with CMOC's similar information system based on Lotus Notes with the emergency response network.

- WMD identification, real time METOC data, and real time feed of WMD indications/warnings/analysis are required for command management of WMD

CONCEPT

CASUALTY MANAGEMENT (CM): Network- centric Casualty Management would transform medical care for civilian and military casualties from a localized process, to a distributed process. In the localized process, each echelon does its best for the casualties presented to it. In the distributed process care of casualties is planned, monitored, and distributed to the best location for that casualty. The status of each echelon and ability to re-distribute the case- load and medical resources would all be taken in to consideration. New tools for casualty estimation, planning, casualty interviewing, event monitoring, clinical reference, patient status reporting and in-transit visibility can provide needed capabilities.

MISSION CONCEPT: Provide coordination between the military force and the domestic Civil-Military authorities to provide managed response to weapons of mass destruction as well as managing casualties in the operations area.

OPERATIONS METHOD: Operate in an urban littoral environment while conducting civil-military operations of a medical nature and provide military use of civilian medical facilities.

SYSTEM SOLUTIONS: Medical Virtual Workspace; Casualty prediction and logistics models; Collaborative Medical Logbook; Multi-lingual Interview System; Incident Watchboard.

HARDWARE SOLUTIONS: DOW; MAT; FORCAS; SHIPCAS; CASEVAC

SUMMARY

CASUALTY MANAGEMENT (CM)

Most CM, as opposed to CMO, occurred later during Phases 2 & 3. Only the DARPA One-Way or Multi-Lingual Interview System (MLSI) was slated for use in Echo. It is a small, portable device for asking non-English speaking casualties about their injuries. The system is a notebook size computer translator capable of translating specific phrases from English into a variety of languages, including Spanish, German, Korean, French and Arabic. The use of the device by medical corpsmen during the Urban Warrior Experiments was to test the system in a real environment, primarily to learn from the experience so that improvements could be made to make it an operationally useful instrument. At this time, the DOW is in the bench-top instrumentation stage. The developers, Dragonfly, Inc., and the DARPA contract monitor, Mr. Ace Sarich, are fully aware of its current limitations.

In the Monterey operation the MLSI was available and several civilian Korean-speaking mock-casualties were brought to the field medical site after a mock explosion. Unfortunately one of the two trained corpsmen was unable to come ashore because of bad weather. This overloaded the other corpsman that was unable to take the time after the explosion and consequent casualty gathering to use the MLSI. The exercise was terminated pre-maturely soon after the casualties were gathered, again because of the worry about helo operations in the fog.

As a result of difficulties in the Monterey operation with media getting in the way, civilians were not allowed in the playbox in the Alameda operations. As a result only limited use of the MLSI was possible there as well because of the need for support from Mr. Sarich.

NPS observers were able to use the DOW in an office environment and observe its performance in the field. Interviews with five Navy corpsmen were conducted after field use in Oak Knoll. Based on these interviews, the DARPA One Way Multi-lingual Interview System is not yet ready for field operational, but does show promising utility.

The primary difficulty was the large number of times the user was forced to repeat the English phrase before the unit was able to match it to the foreign language equivalent. Although the system worked well in a laboratory environment the battlefield environment was apparently too noisy. This is particularly a concern in time stressed situations. Noise suppression is being worked on and should be incorporated into the next trial.

It is likely that the MLSI should be considered a "no-test" in FBE Echo. However medical personnel looked forward to a time when a true two-way translation device will be available for use in refugee treatment situations.

As an adjunct to the FBE-Echo CM, an evaluation of three casualty prediction / management tools was performed: Ship Casualty Projection System (SHIPCAS), Ground Forces Casualty Forecasting System (FORCAS) and Medical Analysis Tool (MAT). The purpose of these tools is assist the medical planners in preparing the medical annex Q to the OPLANS. The tools were tested by stepping through the beginnings of the OPLAN preparation.

MAT requires a basic daily rate of occurrence of casualties as an input. SHIPCAS and FORCAS provide such a rate as their output. Both of the latter are based on historical rates of losses. On the average ships in the Pacific received .3 hits per hundred days engaged in WW!I, for example. The wisdom of planning for such Iow occurrences, even adjusted for more modem circumstances, is very debatable. It would seem more appropriate to base medical planning for an operation on the possibility that one or more ships will be hit, rather than on some long-term average. Neither model had a modem interface and SHIPCAS in particular was difficult to use (translating actual ships into the SHIPCAS categories was difficult) and even dangerous in that the visibility of assumptions and inputs is not maintained for ease of checking. The treatment of uncertainty in the two models differed and was not obvious to the user. An alternative to the use of these models is the existence of a nominal rate of casualties per day that has at least the virtue of transparency. FORCAS and SHIPCAS were given Iow ratings by the assessment personnel.

The Medical Analysis Tool translates the gross casualty rates into demand for resources at any medical support structure that is also input by the planner. The level of detail requires an in depth analysis of medical operations but that is appropriate to the subjects employing the tool. In the opinion of the medical planner involved, it was stated that the outputs were consistent with other estimates for Kernel Blitz. The software has a modem interface and has suitable documentation. Visibility into the calculation is not complete but satisfactory. The assessment personnel rated near the top of the scale and about twice as high as the other two models.

During the USMC CM activities an excellent document "Humanitarian Assistance and Disaster Relief" was encountered. It is one of a series of products of the USMC Warfighting Lab as a quick turn-around digest that is distributed widely within the Corps. A similar product from MBC might be appropriate.

CIVIL- MILITARY OPERATIONS (CMO)

The vision for civil-military operations of a medical nature is to develop a to share information and resources to responding to emergencies. This would allow the military to make maximum use of civilian medical facilities and to provide emergency military aid to civilian first-responders to avoid secondary casualties.

In the Echo phase of Kernel Blitz Prime, CMO was the focus of the efforts that we were asked to assess. These occurred largely in the JMC and in the CMOC space aboard the USS Coronado, part of the Sea-based Battle Lab. A two-day experiment with the California Governor's Office of Emergency Services (OES) in Oakland was performed. The Center of Excellence in Disaster Management and Humanitarian Assistance (COE) provide expertise to the OES's incident reporting system to the CMOC's similar information system based on Lotus Notes. This system, developed by Jim Rogers of COE, utilizes a piece of proprietary software named SoftRisk. The JMC/CMOC was able to receive the California emergency reports via SoftRisk by the end of the exercise via Honolulu, the COE headquarters. In addition UHF, HF and phone circuits were planned.

During the first day communications were not functioning, partly due to a power supply failure. During a scripted terrorist incident near the Bay Bridge, a predicted chorine gas plume was obtained by the JMC from the Lawrence Livermore Laboratory and passed to the OES in about ten minutes by fax, which was difficult to read. Later it was discovered that this plume differed greatly from another plume obtained for the same scripted incident in the VVMD cell onboard the USS Coronado. It is possible that the two different weather sources used were a part of the discrepancy. This incident pointed out the necessity for full communication capabilities and knowledge of the tools being used for sharing predictions with the civilian community.

On the second day the communications were vastly improved and the CMOC responded (provided messages concerning notional support) to about a dozen requests for aid from the OES during the five-hour experiment. Actual airborne imagery was requested and obtained and delivered at the conclusion of the experiment, for example. At the end of the five-hour exercise period the OES personnel came to the Coronado and an after-action review was conducted using the CMOC Group Systems decision support system.. A large amount of information was collected to serve as the basis for future doctrine development. The participants completed a questionnaire in which they rated all aspects except "All appropriate parties were included in the planning" with an average of "Agree". This points out the need for even more broad coordination of actions with the multitudinous civilian authorities. This exercise was focused on the early hours of the incident before FBI and FEMA points of contact would be in place.

Both the OES and the CMOC personnel expressed great satisfaction with the experiment, which was a significant step in the potential direct real-time cooperation for actual emergencies before other command relationships can be established through FEMA, etc.

MEASURES AND OBSERVATIONS

Theme: No single model contains all of the features desired for all sizes of operation but one stands out as most appropriated for the battalion-sized operation.

Hypothesis: Comparison of casualty prediction and planning models SHIPCAS, FORCAS and MAT. Note some additional tools were cancelled due to immaturity or logistical difficulties.

Measure 1: Usability by a typical medical planner.

Measure 2: Process validity & consistency ñ inputs are appropriate and complete and match the output specificity. Outputs are easily translated into required actions such as triage, evacuation, re-supply etc.

Measure 3: Scalability and ability to represent a range of size of operations with at least face validity.

Theme: Test of DARPA Multi-lingual Interview System (MLSI) One-way translator

Hypothesis: The DOW provides an acceptable medium for eliciting vital information from non-English speaking casualties when no local language capabilities are available.

Measure 1: Understandability of questions by the casualty.

Measure 2: Usability of the device by the operator.

Theme: Theatre Medical Core System (TMCS) - Phases 2&3 only

Hypothesis: TMCS provides patient tracking on a near real-time basis and also summary OPORD Annex Q casualty management information.

Measure 1: Time to access patient location from higher echelons.

Measure 2: Accuracy of patient location.

Measure 3: Usability of TMCS.

Measure 4: Visibility of Annex Q information to participants.

Theme: Usability of the StatRef CD-Rom Medical Library

Hypothesis: StatRef is an easy-to-use reference to the latest procedures and treatments.

Measure 1: Usability of StatRef in the military environment.

Measure 2: Breadth of alternatives for treatment considered by the provider.

CIVIL-MILITARY OPERATIONS (CMO)

OBJECTIVE: The capability to interact with civilian authorities in a distributed collaborative planning mode can provide shared information for situational assessment and management of resources in responding to immediate life-threatening emergencies. This will allow the military to make maximum use of civilian medical facilities and provide emergency military aid to first responders to prevent secondary casualties.

SUB-OBJECTIVES: To link the JMC and CMOC aboard the USS Coronado to the regional emergency center by voice and data. To utilize the Counter-Proliferation Analysis and Planning System (CAPS) of Lawrence Livermore National Laboratory with meteorological data to provide predictions of casualties.

HYPOTHESES:

Theme: *Consequence Management of Toxic Releases*

Hypothesis: There are effective civil-military responses to toxic releases.

Measure 1: Military staff and civilian subject matter experts involved in the operation rate the operation as successful.

Measure 2: Military staff and civilian subject matter experts involved in the operation rate the information flow and response as timely.

Measure 3: Connectivity between the afloat authorities and any remote participants is rated as successful.

Measure 4: Modeling to support the experiment was rated as successful.

Theme: *Utilization of the Virtual Work Space display between the JMC and the CMOC*

Hypothesis: A Virtual Workspace can improve the coordination between the JMC and the CMOC.

Measure 1: The military and civilian officials / subject matter experts rate the VWS as successful.

Measure 2: The availability of the VWS is at least 90% of the time the JMC and the CMOC are both functioning.

Measure 3: Discussion of classified information in the JMC does not hinder operation of the VWS.

Theme: *Utilization of the Wireless Infra-Red (WIR) communications for the VWS*

Hypothesis: A Virtual Workspace can improve the coordination between the JMC and the CMOC.

Measure: The connectivity of the VWS is available at least 90% of the time the JMC and the CMOC are both functioning.

SUBMITTED INFORMATION

EVALUATION OF DARPA ONE WAY MULTI-LINGUAL INTERVIEW SYSTEM (DOW MLSI)

Xavier K. Maruyama
March 13, 1999, DLI Monterey, CA
March 17, 1999, Oak Knoll, Oakland, CA

The DARPA One Way (DOW) Multi-Lingual Interview System is being developed by DARPA. The system is a notebook size computer translator capable of translating specific phrases from English into a variety of languages, including Spanish, German, Korean, French and Arabic. The use of the device by medical corpsmen during the Urban Warrior Experiments was to test the system in a real environment, primarily to learn from the experience so that improvements could be made to make it an operationally useful instrument. At this time, the DOW is in the bench-top instrumentation stage. The developers, Dragonfly, Inc., and the DARPA contract monitor, Mr. Ace Sarich, are fully aware of its current limitations.

NPS observers were able to use the DOW in an office environment and observe its performance in the field. Interviews with five Navy corpsmen were conducted after field use in Oak Knoll.

The DARPA One Way Multi-lingual Interview System is not yet field operational, but does show promising utility.

Mechanics:

The system is currently a notebook PC system. With the increase in computation power, it should soon be able to be transitioned into a smaller unit, which would make it more user friendly.

Right now, the users felt that too much attention needed to be paid to the DOW MLSI and this interfered with attention towards the subject being interviewed. A robust hands off unit with which eye contact could be maintained with the interviewee is desired.

Background noise suppression is inadequate. In the office-laboratory environment, the DOW MLSI performed very well in understanding the phrases of the interviewer, but in the field operational environment, there were many instances in which the phrases could not be properly interpreted. An active noise cancellation system is needed. The medical care area usually has a diesel driven generator in close proximity.

User interface:

The phrases were chosen by an shipboard Navy M.D. Field use and future interviews with the field users should allow for a more meaningful and useful collection of phrases to be contained in the system. Here, there is a choice to be made between a unit which contains several languages and limited vocabulary or one which contains a more extensive vocabulary, but limited in the choice of languages. Perhaps an insertable memory chip could be incorporated to provide greater vocabulary in a single language of choice.

The grammar in many cases was too educated. For example, a difficult phrase for the interviewee to comprehend in the stressful field environment was "What is your given name?" A more useful phraseology might be, "What is your name?" Colloquial language may be preferred to more grammatically correct phraseology.

A frustration in its use if that two way language communication is not possible. Given the choice between the DOW MLSI and a human translator, the human translator is preferred. The choice of questions needs to be carefully evolved so that simple yes/no answers can be given. In the stressful field environment, the answer given by the interviewee may not always be simple.

In a medical triage situation, the DOW MLSI may not be as useful as in a humanitarian assistance location where assurance and comfort is needed more than immediate medical attention. In a medical triage area, the corpsman will make judgments based on his/her immediate observation.

The translator is probably more useful to create a less stressful environment for groups such as refugees. It would serve well to reduce frustration and alienation feelings among interviewees.

At least one corpsman said that the Spanish sounded too American in accent and inflection. This is a correctable problem as the system reaches maturity.

All the users recognized the utility of the DOW MLSI, however, they all felt that the device/ system had achieved sufficient maturity for field use. During the Monterey usage, the queries were separated with a computer-generated tone. This was eliminated in the Oak Knoll exercise so that the queries were not as obnoxiously electronic. The user comfort level was higher without this human factor annoyance.

Most of the users felt that the device would have more utility at places such as roadblocks and refugee interview areas. Its usage in for a medical treatment area was limited because of the stress and time factors encountered.

To the casual observer the initial reaction to the DOW MLSI is that it is not effective because there are too many impediments to its use in the stressful field environment. However, if ease of use is improved and noise suppression is achieved, the DOW MLSI has promise for field use.

All users would prefer a human interpreter, but given no other choice, the DOW MLSI is an improvement. A realistic problem to be overcome in a multi-ethnic or multi-cultural environment is the identification of the language to use. A simple systematic means needs to be developed to enable the user to switch to the language which the interviewee can understand. (Because of this problem, even a limited knowledge of foreign languages by the interviewer is extremely useful. This may emphasize the need for the need to teach foreign languages even at the rudimentary level in our national educational systems.)

EVALUATION OF FLEET BATTLE EXPERIMENT ECHO CIVIL-MILITARY OPERATIONS

Xavier K. Maruyama
March15, 16, 1999, USS Coronado, San Francisco, CA
March 17, 1999, Regional Emergency Operating Center, Oakland, CA

During FTBE-E, observation of activities aboard the USS Coronado, tied to Pier 35 in San Francisco, CA, were made as regards to their Civil-Military Operating Center (CMOC) on Monday and Tuesday, 15-16 March 1999. On Wednesday, 17 March 1999, observations were made at the California Regional Emergency Operating Center (REOC) in Oakland, CA. Observations from both locations allow for a perspective not totally available to those who have observed or operated from only one location.

The main operational mission of the REOC is to respond to emergencies and disasters, so the civil disaster response mechanism is much more robust, mature and experienced than that available from the military. At the same time, the US Navy has capabilities which could be a tremendous asset in times of natural disasters and multi-casualty incidents (MCI). These capabilities are not necessarily the analytical capabilities such as plume prediction capabilities, but more logistical support assets. For example, UAV imaging for disaster damage assessment, ship borne equipment transport capacity for regions made inaccessible due to road damage (e.g. Northern California Coast), helicopter assets for medical evacuation and equipment transport and shipboard medical treatment capability when local hospitals are inundated or inoperable are examples of Navy capabilities which can be exploited during a civil emergency.

FTBE-E exercise of the CMOC starkly presented the shortfalls of the current Naval capabilities to render assistance to civilian agencies in the event of disasters or WMD terrorism events. In principal communication was established between the USS Coronado and the California State REOC in Oakland. However, in practice, the means of communication do not exist . Frustrations were felt on both sides because protocol to communicate did not exist.

The issue of non-secure communication arose during this exercise and will arise in future eventualities.

Much of the information that needs to be transferred to civilian agencies exists via the SIPRNET. On board calculation of plume data will be done in an access controlled area and there is no established communication procedure to release the information directly to the civilian agency.

When HF communication was attempted, one individual chief was found who knew how to communicate in a non-secure mode, but it took many hours before that individual was located to perform the task. In a military operation, procedures cannot afford to be individual sailor dependent. A well established procedure to communicate from a secure to non-secure environment needs to be established.

On the other side, the USS Coronado communicated with Pearl Harbor in order to gain access into the California State Response Information Management System (RIMS). This system is also protected from non-authorized use and the authorization passwords were not available during the exercise.

The civilian agencies are well suited to respond to civil emergencies. At the REOC there is capability to communicate with California Counties, capabilities to create large scale maps, and capability to re-allocate resources among the many agencies. The RIMS system is a well established system capable of keeping all affected agencies informed. The Navy Softrisk system appears to be doing similar functions as the RIMS system. There appears to be a duplication of effort in trying to create a parallel system without an in depth knowledge of an operation system (RIMS) with which it will have to interface. If the Navy is serious about assisting in domestic events, it would be worthwhile to allocate personnel to understand civil emergency procedures.

In general, civilian agencies have a greater understanding of military procedures than military agencies understand civilian procedures. This can be attributed to the fact that many of the civilian agency employees have had military experience. Active duty military have not, in general, had experience in similar civilian jobs. To make a positive contribution to civilian disaster relief, the military, especially the Navy, needs to have people who understand civil disaster response. (This is especially true of the Navy since it traditionally have been able to work in isolation from civil affairs. The Army tends to be more aware of civil procedures since they operate more in an environment closer to civilian influence.)

Multiple means of connectivity (e.g. landline, internet, hf, cell phone, etc) are needed in order to avoid single point failure. In addition to the difficulties in establishing non-secure hf links, the server in the CMOC went down several times because a coffee pot was plugged into the same outlet. In retrospect, this appears like a problem which can easily be avoided, but in an emergency situation all circumstances cannot be individually anticipated. Redundancy allows for operational functionality.

Technical content is important. During the exercise, shipboard plume calculations were created with particular local wind and environmental conditions. The output did not reveal what the input assumptions were, so judgement could not be exercised by the operator to determine if the calculated answers were correct or not. In any problem, it is GIGO, Garbage In -Garbage Out. The WMD cell which used a program different from the one used in the CMOC (Livermore ARAC, ARAC, Atmospheric Release Advisory Capability) created a plume picture considerably different from that in the CMOC. The civilian agency also has plume calculations models. The different models calculate differently in detail, but it is not obvious that any of these models are any worse than the other in an environment where rapid response is necessary. The Russian adage "Better is the enemy of good enough" may be operational in calculating plumes during an event. At the least, any model calculation should provide input data to the user.

Communication requires both sending and receiving. Without acknowledgement of receipt of communication, the sender is left in the dark as to whether the communication was received on the other side. Sometimes the problem existed in systems outside of the ships' control. A procedure to acknowledge receipt of message would be helpful to assure the sender that communication is intact. Responding after waiting for action requires waiting for decision and can give the impression that communication links were lost.

In the event that the civilian sector required help from the Navy, there is not clear-cut procedure to ask for aid. At the local command level, it is not clear that a decision to provide aid can be made. Recently, the loss of military bases to BRAC in the Bay Area makes previously established communication links and ties unusable. Is there a DOD wide 911 system to which aid can be requested. Is this done at the Fleet level, National level, task force level or individual ship level?

The UAV imagery would have been a tremendous asset to the civilian disaster response agency. Water and air transport capability may be the only means to reach certain remote areas. These needs could not be provided during this exercise. The Navy should not try to second guess the needs of the civilian agencies, but a rational discussion could be conducted to determine the assets that the Navy can provide. In some instances, it appeared that the Navy was trying to re-invent the wheel.

As a general rule, the civilian agencies can focus on their single mission of emergency response. The military is tasked to do many different things. Rather than creating something totally new, it would be useful for the military to become aware of the civilian capabilities and incorporate them in their procedures.

As a practical matter, should another exercise or experiment be conducted, distinguished visitor access should be severely curtailed. As a practical matter, each time a DV tour was conducted on the USS Coronado, communication with REOC was lost. Demonstrations are fine, but they do not create an environment in which to learn lessons so that practical improvements can be made. FTBE-E at San Francisco was more a show than a learning experiment.

APPENDIX

A. ASSESSMENT PLAN

DATA COLLECTION AND ASSESSMENT PLAN

BACKGROUND

The Fleet Battle Experiments (FBE) are CNO-initiated series of operational experiments for the purpose of examining emerging systems, technologies and concepts. The Maritime Battle Center (MBC) of the new Navy Warfare Development Command (NWDC) is the CNO's agent for planning and implementing these experiments in conjunction with the numbered Fleets. FBE-E is the fifth in the series and is under the operational sponsorship of Commander Third Fleet (COMTHIRDFLT) in San Diego. The Naval Postgraduate School (NPS) has been asked to perform assessment for FBE-E during March and April 1999. The name for the Spring 1999 evolutions of which FBE-E is a part is KERNEL BLITZ 99 (KB 99).

FBE- Echo will draw upon the experience of the four preceding experiments, most directly on the FBEs Alpha and Bravo which were also COMTHIRDFLT experiments. In particular there are follow-ons to the Precision Engagement, Network Centric Land Attack and Theatre Aircraft and Missile Defense (TAMD) from Alpha and the targeting process from Bravo. As with the first experiment, Echo will occur in conjunction with Marine Corps (USMC) Advanced Warfighting Experiment (AWE). FBE-E is in conjunction with the USMC URBAN WARRIOR exercise for Phase 1 in Northern California and with the Extended Littoral Battlespace (ELB) Advanced Concept Technical Demonstration (ACTD) called Littoral Lightning during Phase 2 in Southern California.

Limited Objective Experiments (LOE) will continue in Phase 2 and 3. Phase 3 of KB 99 is in association with the KERNEL BLITZ Prime joint amphibious exercise at Camp Pendleton. NPS assessment will focus on Phase 1 (10-25 March) and to a lesser extent on Phase 2 (10-16) April, with only concern supporting analyses in casualty management/civil affairs, command and control and the SACCEX in Phase 3 (19-30 April).

FBE-E will highlight new operational concepts and capabilities for dealing with Full Dimensional Protection with asymmetric threats in urban environments, network-centric undersea warfare, and also in Precision Engagement with fusion and reachback for information support of targeting and dynamic weapon-target against urban and Weapon of Mass Destruction (WMD) targets.

EXPERIMENT CONCEPTS AND APPROACH

NPS has performed assessments for several Joint Warrior Interoperability Demonstrations (JWIDs) and routinely for the ONR Adaptable Architecture for Command and Control (A2C2) laboratory experiments. NPS personnel were also involved in the All-Service Combat Identification Evaluation Team field tests in 1995 & 1996. The Modular C2 Evaluation Structure (MCES) is a tool developed at NPS in conjunction with the Military Operations Research Society (MORS) for stepping through quantitative assessments that has applicability for FBE-E. NPS has conceptually applied the MCES in helping to define measures to gauge the success of each of the major areas of FBE-E.

The concepts being explored in FBE-E are the following from the MBC FBE-E Experimentation Plan:

- Full Dimensional Protection
- Asymmetric Threat
- Network-centric ASW with collaborative multi-sensor planning
- Theatre Air and Missile Defense (TAMD)
- Precision Engagement (PE)
- Other analysis / experimentation areas: Information Superiority and
- Casualty Management / Civil Military Affairs which will be conducted in all three phases.
- Limited Objective Experiments (LOE) are continuation of the ASW and PE into later phases.

Although the FBEs are labeled Experiments, they are not laboratory experiments but are operational experiments or better yet, explorations of new concepts, technologies and processes. In FBEs to date there have seldom been opportunities for experimental replication (several runs under controlled conditions) or control groups that constitute the standard case or experimental designs that systematically vary the very large number of factors in the operations. Usually the base case or standard is simply the "usual process and results". Perhaps more important than whether the specific experimental processes worked in this FBE, are the insights into how they can be made better for the next FBE. The FBE-E plan emphasizes the experimental process, establishing a baseline and gathering data to assess and mature the concepts.

Given these goals, NPS recommends the emerging principle of "model-test-model" for the FBE to the extent possible. Following this principle, simple models of the processes will be suggested that can give an indication of the conditions necessary for the success of the specific experiment or even the general area. These models can be helpful in setting up FBE-E and, if compared against the actual results of Echo, may be even more useful in indicating directions for the next FBE by extrapolation in future, improved modeling or by indicating the need for Limited Objective Experiments (LOE) before the next FBE. In some cases more sophisticated models are available for the experiment through the presence of simulations or decision aids that can provide additional runs for extrapolation.

Building the stable of these tools is an important goal for the FBE series.

FBE-E NETWORK INSTRUMENTATION AND ANALYSIS

SCOPE

Fleet Battle Experiment Echo will conduct Bandwidth Analysis of selected Local Area Networks, (LAN's) and Wide Area Networks, (WAN's) to evaluate communications performance during FBE-E using the SNIFFER monitoring system.

TECHNICAL REQUIREMENTS

The SNIFFER system will utilize Network analyzers and evaluators to collect data both manually and automatically through direct observation and microcomputer-based monitoring devices, "sniffers". Automated data extraction will be accomplished through the use of Local Area Network (LAN) monitoring devices (sniffers) to quantitatively measure the amount of data exchanged over the Local and Wide Area Networks (LANs and WANs). This data represents the communications link between FBE-E systems that depend upon the LAN/WAN infrastructure for communications. The network test will involve multiple sites that utilize interSIte LAN/WAN connectivity. The Network monitors will be programmed to filter addresses and gather network usage statistics based on source and origination addresses. The data gathered during the execution of the exercise will be used to obtain network loading, traffic analysis, and recommendations. Another segment of the network performance analysis is the record of subjective/ observed network performance issues. Observations such as garbled voice, slow image transfer, low performance over a video teleconference session, will be recorded with time stamps (if such data is recorded), then made available to the network analysis group. This data will help isolate causes of problems in network performance.

ASSESSMENT PLANS FOR EACH CONCEPT

MARITIME DOMINANCE

COUNTERING ASYMMETRIC THREATS

The objective of this area is the improved protection of high-value units (HVU) at off shore anchorage or in port from asymmetric threats. Asymmetric here implies nonCOnventional or non-military threat, i.e. terrorists. Such threats range from combat swimmers to jet-skis to civilian aircraft with chemical or biological aerosols (WMD). The integration of sensors and networks with existing weapons is the central means for accomplishing the goal. The network will be directed by the Mobile Inshore Undersea Warfare Unit (MIUWU) and be coordinated with the USW cell on-board the USS Coronado. These activities will occur only during Phase 1 in conjunction with URBAN WARRIOR.

The ultimate purpose of the defense against asymmetric threats is to deter attack. Because this portion of FBE-E will be one that employs an actual OPFOR it should be possible to measure the degree to which they are kept off-balance and discouraged by our force protection activities as well as how effective we are in protection against the specific attacks. The placement of command and control within the mobile MIUWU is one step in this direction. Our ability to take away the initiative will depend upon Intelligence Preparation of the Battlefield (IPB) in new and possibly unique ways.

Previous FBEs have not featured asymmetrical threats of this nature. Because of the unusual nature of these threats and the small number of possible unalerted trials, the model- test-model approach is appropriate. NPS / Crane are developing initial models for some of the threats below. These simple models of the anticipated environments should be useful in determining experimental conditions and thresholds before FBE-E. After FBE-E they may prove useful in extrapolating the threat and zones of protection to reflect operations under more realistic conditions and with revised procedures.

Hypothesis 1: Combat swimmers can be detected by the Mobile Inshore Undersea Warfare Unit (MIUWU) and other swimmer detection systems and countered by coordinated operations of the Port Security Unit (PSU).

Measure 1: The percentage of trials in which swimmers are detected before reaching unit and estimated range at which detected. Modes of detection and confirmation and time to sort and declare threat should be recorded. Swimmer mode (surface, open circuit and closed circuit) and visibility conditions should be noted.

Measure 2: Time from detection to prosecution of detection by response force. This includes time to communicate to HVU and the PSU and time to alert and activate effective responses (weapon to bear on visually identified target at effective range).

Implementation: It is planned that the MIUWU will record data and maintain the picture to be sent to the USW cell. Tip-off of likely swimmer threats will be provided in the MSEL. Event logs and interview / questionnaires will be obtained from the participants by the observers in the MIUWU and on board the HVU and PVUs. The end game of interception of the swimmer after detection and activation of response will not be assessed because of swimmer safety issues.

Hypotheses 2: Attached mines can be located more quickly using a hand-held sonar.

Measure 1: Ratio of time to locate mines attached to ship with and without the sonar.

Measure 2: Usability of the hand-held sonar.

Implementation: At least some of the attacks will culminate in emplacement of pseudo-limpet mines on the HVU in designated positions. Different EOD swimmer teams will attempt to locate the mines with half the teams using hand-held sonar locating devices. Time to find the mines will be observed beginning with entering the water at the HVU. A questionnaire will be issued to the participants concerning the features of the hand-held sonar to gain insight into the practical application of the device. The searches will not be modeled.

Hypothesis 3: Networked multi-sensor surveillance and response forces in layered defense can counter asymmetric small-boat attacks.

Measure 1: Ranges at which attacks are detected and at which they are declared threats.

Measure 2: Time to initiate coordinated response to potential (sometimes WMD) threat after threat is detected, engaged or device is planted (final event of sequence).

Measure 3: Perception of false alarms, fratricide and collateral damage risks.

Implementation: The MIUWU will record tracks and observers will maintain logs. Video camera recording by observers should begin on detection and continue throughout event. Traffic and visibility should be noted at frequent intervals between events to establish baseline. Declared threat level, readiness levels, ROE changes, IFF procedures, system downtimes etc. should be noted regularly. Modes of detection and confirmation are important and communications log must be kept.

Hypothesis 4: Networked multi-sensor surveillance and response forces in layered defense can counter attacks from personal watercraft (jet skis).

From an assessment standpoint this is the same as Hypothesis 3 so measures and implementation are the same as above. However the range and velocity may make it very difficult to respond in a timely manner.

Hypothesis 5: Networked multi-sensor surveillance and response forces in layered defense can counter night attacks on anchored HVU by covert rubber boat with SEA SHADOW drop-off. This is somewhere between swimmer attack and small boat attack in the importance of surprise.

Measure 1: Percentage of the attacks in which warning is given by the MIUWU.

Measure 2: Percentage of the attacks that are detected by the HVU.

Implementation: To avoid tipping off the HVU, video recordings of the event will be made only from the SEA SHADOW or other drop-off ship. Logs of the HVU, MIUWU and the attack participants will be compared for determination of the successes and a questionnaire administered for insights into the reasons for non-success.

Hypothesis 6: Networked multi-sensor surveillance and advanced detection and management systems can mitigate effects of asymmetric WMD attack from low, slow-flying aircraft.

Measure 1: Ranges at which attack is detected and at which it is declared threat.

Measure 2: Time to issue WMD warning.

Measure 3: Time to initiate coordinated response to potential WMD threat after detected, engaged or device planted (final event of sequence).

Implementation: A larger number of sensors and participants are anticipated for this event. The MSCT tool for analysis of air tracks will be used to baseline activity in the area (possibly also for ship tracks). Again, the MIUWU will record tracks and observers will maintain logs but the LSS and air pictures are needed. Video camera recording should begin on detection and continue throughout event. Traffic and visibility should be noted at frequent intervals between events to establish baseline. Declared threat level, readiness levels, ROE changes, IFF procedures, system downtimes etc should be noted regularly. Modes of detection and confirmation are important and communications logs must be kept. DSWA analysts and software should be utilized for data recording.

Hypothesis 7: Networked multi-sensor surveillance and response forces in layered defense can counter night attacks on the HVU anti-ship missiles launched from a truck which exits a known holding area and proceeds to a launching area in the hills above harbor. Tip-off may come from USMC recon patrol on watch above Concord NWS.

Measure 1: Percentage of times exit is detected.

Measure 2: Percentage of time truck is detected in logical launch position or condition before simulated launch.

Implementation: These runs will be conducted when UAVs are available to surveil the holding area and/or the potential launch areas. A GPS track on the truck should be maintained. Logs of the UAV control stations can be compared to the track. Separately as part of the Precision Engagement effort, the launch points and holding area should be examined for targetability and the link from UAVs through processing and targeting should be timed for responsiveness.

Hypothesis 8: Intelligence Preparation of the Battlespace (IPB), advanced sensors and networked control of the PSU by the MIUWU will allow more effective positioning and employment of the PSU against the variety of asymmetric threats.

Measure 1: Ratio of time to reset protective grid using MIUWU control to time without reset control.

Measure 2: Ratio of detections with IPB to that without IPB.

Implementation: During first two days (15 & 16 March) MIUWU will designate end of each trial and tell PSU where to reposition for next run. PSUs will report when ready on station. During second period (17 & 18 March) MIUWU will not reposition units but time to ready positions will be recorded. For measure 2, for each set of attacks, an attack from directions / times outside of those determined in the IPB will be attempted probably late in each set of trials. In addition to these more controlled comparisons, if possible some "baseline trials" outside of MIUWUCOntrolled events may be possible for some forms of attack. Observer and participants will contribute subjective assessments of this hypothesis.

DATA COLLECTION FOR COUNTERING ASYMMETRIC THREATS

Asymmetric threats will occur in limited areas and numbers and are brief so it should be possible to make video recordings of most of the trial events. An observer should make the recording on the platform being attacked in most cases. In addition observers should be made part of the attacking force where practical. The MIUWU will be the central element and an observer there should make sure that systems logs and logs of actions and position/location data streams are obtained from the system during trials. A video of the activities in the MIUWU during trials may also be useful. The IPB activities should also be observed and logged and any predictive defensive activities noted. Timelines of response to the attacks are vital.

It will be necessary to have two shifts of observers in the MIUWU. An observer in the USW cell on USS CORONADO will also be required but only during trials and may perhaps share duties in the USW function. The activities in the WMD cell must also be observed and logged but again that duty may be shared across other functions such as PE.
In addition to the quantitative data above it will be necessary to collect perceptions of the OPFOR and other participants as to the practicality of the protection processes and their effectiveness. Insights into improvements will also be solicited on the questionnaires.

NETWORK-CENTRIC UNDERSEA WARFARE (USW)

The objective of network centric undersea warfare is a fully integrated undersea warfare capability contributing to full dimensional protection for forces in and beyond the Joint Area of Operations (JOA). Network-centric anti-submarine warfare using distributed collaborative planning for multi-sensor search and prosecution is the FBE-E concept for addressing this goal. An ASW Cell with improved connectivity, standardized models and databases will stand-up for training and contingency operation planning in FBE-E and will conduct both planning and execution during the associated Limited Objective Experiment (LOE). USW has not been a major area in the previous FBEs.

The assumptions that drive this USW concept include availability of enhanced:

- C4I systems that provide high data rate connectivity,
- fusion of a detailed underwater picture with surface and air pictures,
- search planning and assessment tools,
- battle management tools, and remote sensor management tools,
- sensor systems that provide passive acoustic, mono-static active acoustic, multi-static active acoustic, non-acoustic detections plus environmental characterization, and
- Weapon systems for shallow water ASW, for loitering and in support of distributed sensors, mine neutralization, and non-lethal options.

For FBE-E these assumptions will clearly not be met, but some will be approximated or simulated by the ASW Anchor Desk as necessary to conduct the experiment. The Anchor Desk will have enhanced connectivity to ships, submarines, aircraft, national assets, environmental information resources, sensor platforms and other command centers.

For this experiment, the ASW Anchor Desk will be within the USW cell onboard USS CORONADO. It will perform the following functions:

- Develop and evaluate ASW search plans to support the fundamental campaign mission. For FBE-E, this mission will be advanced force operations in preparation for and amphibious assault. Maintain and distribute submarine threat data and cueing to sensor platforms. Fuse and distribute the coherent tactical and operational level pictures of the undersea battlespace. Evaluate the effectiveness of completed searches to identify the remaining threat. Consolidate and analyze inSItu environmental data from dispersed sensors. Cache and distribute METOC data and serve as the tie point for reachback to shore based support.
- Manage the collaborative search planning process and employment of remote sensors.
- Search plans from the Anchor Desk will be distributed to the affected units for update with local environmental information, assessment of compatibility with other assigned warfare duties and assessment of risk to that unit.
- The capabilities to be explored in network-centric USW include a CONOPS for fusing all available information, distributed collaborative planning with shared models and databases, visualization of the essential elements of information (EEI), deconfliction of sensors, and management of unmanned sensors. The specific experiments in network-centric ASW portion are discussed in the paragraphs below. Initial hypotheses and approaches to measures are indicated and implementation of the measures is discussed.

During FBE-E, the ASW operations will be limited to advance planning of ASW operations in support of the amphibious assault occurring in a later phase of KERNEL BLITZ. During the LOE, ASW operations will expand to include real time search planning, execution of these plans and an examination of alternative concepts for waterspace management enabled by a CTP and improved communications to BLUE Force submarines. The NPS assessment will focus on the LOE.

Hypothesis 1: A collaboratively developed area ASW search plan improves overall search effectiveness.

Measure 1: Ratio of the integrated, predicted probability of detection for the collaboratively developed plan over the aggregated predicted probabilities of detection of the independently developed search plans.

Implementation: In a model-test-model mode, search plans for the expected conditions can be developed before the FBE-E and compared to give a rough idea of the expected ratio. A threshold (like 1.3) should be agreed as the success criteria based on the results from the modeling. Doing this modeling before FBE-E will serve as a feasibility check as well. During FBE-E the platforms can develop their independent plans and the observers can compare the predicted detection capabilities to that of the collaborative developed plan managed by the ASW cell. Since this comparison is best accomplished by comparing snapshots of the various detection probabilities, several time stamped samples over the course of the LOE are required. An average of these ratios should be compared to the threshold.

After the LOE, a comparison of the ratio from the actual experiment and the ratio from the earlier modeling should be explored to identify potential weaknesses in the process.

Measure 2: Responsiveness of collaborative planning to changes in conditions. Although responsiveness might differ from that of independent planning, these differences will be very condition and situation dependent.

Implementation: Since this measure is so condition and situation dependent, it will be evaluated through a subjective questionnaire and narrative log-book to collect commander and operator impressions and insights.

Measure 3: Practicality of collaborative planning. This measure includes communication requirements, software incompatibilities, training difficulties etc.
Implementation: This measure is also rather subjective and will be addressed using a subjective questionnaire and narrative logbook to collect commander and operator impressions and insights.

Hypothesis 2: The use of identical, high-fidelity models and associated databases by all ASW participants improves the overall understanding of the overall search plan and individual sensor performance. Additionally, the use of a common model allows "drill-down" into the factors affecting performance.

Measure 1: Value added to the planning process and the ability to effectively employ sensors.

Implementation: A subjective questionnaire based survey and narrative logbook to collect commander and operator impressions and insights along the following themes:

How does the use of common, high fidelity models and databases to visualize aspects of the overall search plan aid or hinder an individual platform's assessment of his risk in executing the search plan. (For example, how does the overall plan support the self-defense issues of a platform tasked to conduct active acoustic search?)

How does the use of common, high fidelity models and databases to visualize aspects of the overall search plan aid or hinder an individual platform's understanding of his tasking and contribution to the overall search?

How were high fidelity models and databases used to support tactical employment of sensors?

How did high fidelity models and databases contribute to the development of the tactical picture, i.e., target localization based on physics based modeling of sound propagation (detection envelope structure), analysis of the range dependence of various aspects of the target's signature structure?

Hypothesis 3: Time integration of the tactical undersea picture provides additional significant information for all ASW echelons compared to the current real-time tactical picture alone.

Measures: This is an exploratory effort to identify the comparative Essential Elements of Information (EEI) and the insights that can be gained at different ASW echelons from the timeINTegrated picture. (i.e., derivation of operational patterns, etc.)

Implementation: Again, a subjective questionnaire will be used to gain insights concerning this hypothesis. The questions will focus on describing the tactical insights gained through time integration and how to exploit these insights.

Hypothesis 4a: The undersea tactical picture provides sufficiently timely positional and operational information for BLUE Force submarines to safely enable dynamic Weapons Exclusion Zones around BLUE Force submarines.

Hypothesis 4b: An ASW Joint Engagement Zone (JEZ) will allow more successful prosecution of an adversary submarine than the current exclusive waterspace management policy protecting BLUE Force submarines. (Note the JEZ assumes a common tactical picture containing timely track information for BLUE Force submarines and reliable, real-time communications between BLUE Force submarines and the rest of the ASW forces.)

Measure 1: Percentage of time that the sub was outside of the dynamic Weapon Exclusion Zone under various conditions. Note that success threshold for this measure is very close to zero.

Measure 2: Ratio of percentage of detections converted to successful prosecutions in BLUE Force Submarine Operating Areas using the JEZ deconfliction method over the percentage for the traditional exclusive waterspace management method using NOTACK procedures.

Measure 3: Ratio of percentage of detections converted to successful prosecutions in BLUE Force Submarine Operation Areas using the JEZ deconfliction method with continuous, two-way communications to the submarine over the percentage for a modified JEZ deconfliction method with continuous, one-way receive only communications to the submarine.

Measure 4: Tactical impact of two-way communications with BLUE Force submarines through systems such as ACOMMS.

Implementation: For measures 1, 2 and 3, model-test-model is applicable here again because a number of prosecution opportunities with multiple submarines and prosecution assets are required for a robust test, which may not be possible achievable given that the orange submarines are not limited to structured geometry runs. Before FBE-E a scenario should be built and modeled to obtain an estimate of a suitable success threshold.

During the experiment, a ground truth reconstruction of all relevant participant tracks, blue and orange forces, will be produced from the detailed position and operational reporting from each participant.

Reconstruction will assess:

- Validity of reported detections,
- Success of reported engagements,
- Missed detection opportunities, and
- Effectiveness of the JEZ deconfliction methodology.

For measure 3, a subjective questionnaire will be used to gain insights concerning this hypothesis. The questions will focus on describing the advantages gained, limitations incurred and methods to tactically exploit this type of communications capability.
Hypothesis 5: The sensor network and contact management capabilities of the ASW network provides an improved ability to "finger-print" and conduct all source overt or covert tracking of high interest WHITE shipping in support of:

Area defense against covertly armed shipping,
Counter-proliferation operations,
Counter-narcotic or other counter-smuggling operations.

Measure 1: Percentage of correct target classifications, identifications and signature correlations.

Measure 2: Riment area.

Implementation: The experiment will exploit merchant traffic conducting routine transit of the exercise area without interfering or communicating with the ships. As a result, the ships will not report their ground truth tracks. The experiment control group charged with selecting suitable ships for the experiment will determine these parameters. The assessment will be conducted by comparing classification, identification and track data reported in the ASW network to the "ground truth".

DATA COLLECTION FOR NETWORK-CENTRIC USW

The COP for the LOE should be preserved for analysis. The RECAP logs of the ships and the P3 log (ORION) should be reported every four hours to the USW cell for ground truth. The estimated positions of all participating units will be tracked and preserved in the IMAT system. The biggest difficulty is the position of the subs. The submarines will make RECAP reports at every communication period. The IMAT histories will be maintained. In Comparison to the Asymmetric Threat function, a more continuous record is required because the trials are largely undefined because of the non-observable interactions with the submarines. However the nearly continuous track in the USW cell may make it possible to video tape the action in the cell at important moments.

Environmental data is especially important for USW analysis. Modular Ocean Data Assimilation System (MODAS) data will be transmitted to IMAT every 12 hours. The units' Directional Ambient Noise will be will be reported maintained on the WeCAN and archived. The WeCAN will also maintain commanders notes and message traffic.

Observers will be necessary in the USW cell on USS Coronado and also on major surface participants although some sharing of duties on the other platforms may be possible.

In addition to the data above, a subjective questionnaire for the capture of perceptions will be used at the end of the experiment phase for all participants.

JOINT THEATRE AIR AND MISSILE DEFENSE (JTAMD)

JTAMD has been an important player in the FBEs to date. In FBE-E it must provide defense against conventional aircraft, theatre ballistic missiles and cruise missiles. In addition to the AEGIS / LINEBACKER capabilities it will draw upon other sensors for asymmetric threats. This area's objective is to explore the ability of the Expeditionary Force to make use of in-place civilian sensors to help establish a defensive grid. These sensors include airport and harbor radars and the supporting civilian communications system.

UAVs, national assets and appropriate military systems will also be used as available. Fusion and control will be from USS CORONADO and the MIUWU as the asymmetric threat response cell. Defensive Directed Energy Weapons (DEW) will be simulated.

In addition to maintaining an air picture with diverse sources active defense, JTAMD will include attack operations including planning and simulated execution of launch platforms, C2 nodes, missile stocks and infrastructure. Special software to support the planning will be installed on USS CORONADO and fire missions will be passed to LAWS.

Hypothesis: The addition of information from civilian in-place systems can significantly improve the fused picture of air and surface conventional and asymmetric threats.

Measure 1: Range at which a low, slow-flying threat can be detected and tracked.

Measure 2: Range at which asymmetric surface threats can be detected.

Measure 3: Time of warning of launch or range at which asymmetric cruise missile can be detected and engaged.

Measure 4: Fraction of population warned of asymmetric threat.
Implementation: To a large extent this area concerns adding civilian air track information and sophisticated processing to the force protection picture being generated in the Asymmetric Threat areas above. Measures 1 and 2 occur again below against the same threats and are treated in more detail there. Measure 3 assumes a cruise missile threat similar to that described below as well, but extends into the track and engage portions of the event. A model for this portion would be useful for both simulation and stimulation. A suitable model is not yet known to be available. Measure 4 can only be tested as far as passing of the warning from the military to civilian authorities. An event log should be kept for this purpose. To a large extent the success of this area will be assessed at two levels. The first is the ability to provide connectivity to the potential sources of information in an interoperable manner. This should be established by having the Force Protection Cell members (aided by observers) establish a log for nets and sources to be maintained during phase 1. At the next level is the added value of this information to that provided by organic assets.

Because of the qualitative nature of value added a questionnaire will be administered by the observers at the change of shifts in the Force Protection Cell to obtain their ratings on a five-point scale. The design of the questionnaire should include identification of the specific contributions of the various sources if possible. Otherwise the value may have to be determined for the aggregate of "non-organic" sources.

PRECISION ENGAGEMENT

Precision Engagement involves a diverse range of activities, including research and development, command and control and target designation. The processes to be examined in FBE-E will be targeting, fire order generation and dissemination – specifically, precision targeting of time sensitive surface targets, urban precision engagement and 4 dimensional (4-D) deconfliction. Targeting is the process of selecting adversary forces, geographical areas, installations, or activities planned for capture, degradation, destruction or neutralization by military forces and matching the appropriate response to them. The model used to describe how targeting is accomplished is called the targeting cycle. The targeting cycle is divided into six phases: objectives and guidance, target development, weaponeering, force application, execution planning/force execution and combat assessment. FBE-E will examine targeting procedures and advances in technology that may improve our ability to hit targets in an urban environment and be able to rapidly target and employ platforms/ weapons against time sensitive surface targets (land and sea surface targets).

4-Dimensional (4-D) deconfliction is the process of deconflicting small volumes of airspace and ground areas that move with time. Each missile, bullet, aircraft and friendly ground operating area will have a "bubble" around it. Speed, ability to react and whether the missile, bullet, aircraft or friendly ground area is manned or unmanned will determine the size and shape of the "bubble". Recent improvements and impending improvements in technologies allow us to change our deconfliction procedures. 4-D Deconfliction will experiment with changes in tactics, techniques and procedures used for deconfliction based on improvements in capabilities produced by changing the concept of how we do deconfliction.

For clarity sake, the FBE-E and Limited Objective Experiment (LOE) Precision Engagement processes discussed above are grouped under three execution groups:

RING OF FIRE (ROF) – Rapid reaction network-centric warfare in an urban environment while simultaneously conducting interdiction, strike, and counterfire;

VICIOUS BLAZE (VB) – Deliberate targeting (6-48 hours) experiments, examining all source imagery fusion, manipulation, and dissemination, and afloat roles in on-line electronic target folder (ETF) production;

SILENT FURY (SF) – Utilization of tactical reconnaissance to support reactive targeting (<2 hours) in a dynamic environment.

OBJECTIVE: Explore and evaluate targeting processes and technology to accurately place munitions on designated targets in a time constrained environment.

HYPOTHESIS: Current weapons system targeting processes are disjointed and do not exploit available technologies. precision engagement is a resource-demanding endeavor that sacrifices execution speed for accuracy. fbe-e will experiment with new technology and supporting tactics, techniques, and procedures (ttp) with the intent of improving integration among weapon systems and between operations and intelligence efforts. such activity will result in improved speed and accuracy of the targeting, planning, and execution processes, and reduce requirements for restrikes. airspace deconfliction resulting from flight path conflicts, weapon trajectories, weapons effects, friendly aircraft, and unmanned aerial vehicle (uav) flight are also problems that constrain the use of long-range weapons. improved technology and new ttp explored in fbe-e may allow inefficient airspace procedures to be amended for greater weapons effectiveness.

IMPLEMENTATION: Explore, examine, and evaluate: targeting and effects of naval fire support in an urban environment; sensor to shooter continuum versus fixed and mobile targets; integration of imagery feeds and targeting tools in support of reactive and deliberate targeting; ability to rapidly deconflict airspace using 4-d near-real-time deconfliction; and conduct targeting and live missile shots in a gps jamming environment.

Maximize use of GENSER SIPRNET LAN and WAN while ensuring distribution of imagery and electronic target folders to all customers. Maintain tasking authority for all FBE-E imagery sensors within the Joint Strike Center aboard USS CORONADO.

DATA COLLECTION AND ANALYSIS PLAN

- Key metric for our measures of effectiveness are accuracy and timeliness of the targeting data provided, qualitative assessment and satisfaction of customer requirements.
- Evaluate the increased effectiveness of the engagements using networked systems
- Evaluate time to complete process allowing Watchstander to commit decision.
- Evaluate ability to monitor available friendly response assets.
- Evaluate probability of adequate weapon to target match (effectiveness).
- Evaluate time to complete activity (time).
- Evaluate ability to update orders, data and control info to attack on own and supporting platforms (update capability).
- Evaluate ability to receive clear and sufficient orders and data (reliability).
- Evaluate probability of transmit to target acquisition point (receive ability).
- Evaluate time to respond.
- Evaluate probability of transit to target acquisition point (survival probability).
- Evaluate time to perform specific tasks (time).
- Evaluate quality of task product.
- Evaluate usability human interface to equipment.
- Evaluate human workload processing rates of information (e.g. messages per second)

CASUALTY MANAGEMENT AND CIVIL MILITARY OPERATIONS

Casualty Management

The Third Fleet Surgeon's office has proposed a number of experiments for FBE-E in both Casualty Management and Civil-Military Operations. In this area the use of model-test-model is not appropriate at this time because of the early stage of development and the difficulty of identifying and assessing specific outcomes for the experiments. Instead a qualitative approach will be taken to produce assessment and some insights.

COMPARISON OF CASUALTY PREDICTION & LOGISTICS MODELS MAT, FORCAS, SHIPCAS, AND CASEVAC (PRE-PHASE 1 AND PHASE 3)

A comparison of four existing models of casualties will be conducted for the KB' phase of FBE-E's amphibious landing. The comparison will be initiated prior to the exercise. The comparison will be executed during the exercise as a final test of usability.

Hypothesis: No single model contains all of the features desired for all sizes of operation but one stands out as most appropriated for the battalionSIzed operation.

Measure 1: Usability by a typical medical planner.

Measure 2: Process validity & consistency - inputs are appropriate and complete and match the output specificity. Outputs are easily translated into required actions such as triage, evacuation, re-supply etc.

Measure 3: Scalability - ability to represent a range of size of operations with at least face validity.

Implementation: Measures 2 & 3 will be explored before FBE-E in order to prepare instruments for use in KB'. A written critique of these measures will be presented for each model. Measure 1 will be based on a subjective assessment by the KB' medical planner on a number of features. A log will be kept by the planner during execution in KB' identifying problems and performance.

MEDICAL COLLABORATIVE LOGBOOK (MEDLOG) (PHASES 1-3)

MedLog is part of the COMTHIRDFLT LAN services that is used for preparing briefing material within the COMTHIRDFLT staff. MedLog will become the day-to-day tool for displaying the status of medical activities. This event integration tool will be used in all phases of FBE - Echo both internally and for integration with other aspects of operations including summary statistics, briefing preparation and presentation.

Hypothesis: MedLog is a convenient system for theatre-level situational awareness and daily management.

Measure 1: Usability of MedLog.

Implementation: this calls for a subjective evaluation on a number of features using a 5-point scale for participants to fill out at the end of each phase.

MULTI-LINGUAL INTERVIEW SYSTEM (DOW) (PHASE 1)

This experiment uses the DARPA One-Way (DOW) hand-held voice-actuated computer to interview casualties with foreign language capabilities in Phase 1.

Hypothesis: The DOW provides an acceptable medium for eliciting vital information from non-English speaking casualties when no local language capabilities are available.

Measure 1: Understandability of questions by the casualty.

Measure 2: Usability of the device by the operator.

Implementation: A group of volunteer participants with English and foreign language capability will be obtained prior to Phase 1. They will be given a designated injury and symptom list. They will be interviewed entirely by the DOW speaking in the language of their capability. They will write their understanding of the question in English along with the answer. For measure 2 a 5-point scale questionnaire will be administered to the interviewers at the completion of the interviews.

INCIDENT WATCHBOARD (PHASE 1 AND 2)

This Web-based adaptation of the USMC CBIRF tool for tracking events and casualties will be tested for suitability.

Hypothesis: Incident Watchboard (IW) can raise the situational awareness during a crisis at multiple levels of decision-makers.

Measure 1: Usability of IW in the shipboard and ashore environments.

Measure 2: Impact or value-added by IW to decision-makers.

Implementation: Subjective evaluations based on replies to a 5-point questionnaire provided to the participants. Measure 1 will be rated on a number of features to be developed. For measure 2 the participants will be asked to compare to "normal" conditions without IW.

THEATRE MEDICAL CORE SYSTEM (TMCS) (PHASE 2 & 3)

The TMCS is a web-based DoD tool that can track patient information from Local Data Entry Tool (LDETs) or MeWS at lower echelons for reporting and resource management. It can be made easily available to staff to improve visibility of patient and resource status in everyday operations.

Hypothesis 1: TMCS provides patient tracking on a near real-time basis and also summary OPORD Annex Q casualty management information.

Measure 1: Time to access patient location from higher echelons.

Measure 2: Accuracy of patient location.

Measure 3: Usability of TMCS.

Measure 4: Visibility of Annex Q information to participants.

Implementation: At prescribed times the status of a sample of patients known to be in the system will be queried and the time to report recorded. An independent verification of the actual location will be made by observation or call to locations. Usability will be assessed by a questionnaire as covered for MedLog above. Visibility and completeness of the Annex Q information will be assessed by regularly noting the connectivity and by questionnaire.

MOBIL MEDICAL MONITOR V

(Now MeWS - Medical Work Station) (Phase 3)

MeWS is a new portable field diagnostic tool with which care providers can which collect patient vital signs and transmit them along with patient smart card ID and field notations to the TMCS or other major stations. It can also serve as a Local Data Entry Terminal (LDET).

Hypothesis: Semi-automatic collection and transmittal of physiological parameters from bedside will more speedily and accurately update local and higher level information systems.

Measure 1: Ratio of time to update patient status in TMCS from MeWS divided by usual time for recording and transmittal.

Measure 2: Usability of MeWS.

Implementation: In Phase 1 the MeWS will be introduced to USS ESSEX and initial training and assessment of usability performed. In Phase 3 it will be implemented in the Ashore and Afloat Casualty Management Exercise. A log will be kept of times to report using MeWS and without using MeWS on a matched split of the casualties.

STATREF AS FIELD REFERENCE LIBRARY ON CD- ROM

Stat Ref is a standard medical treatment reference of 28 textbooks now available in updated form on CD-ROM. Its availability in all treatment centers could improve the currency of alternative procedures considered for treatment at low cost.

Hypothesis: StatRef is an easy-to-use reference to the latest procedures and treatments.

Measure 1: Usability of StatRef in the military environment.

Measure 2: Breadth of alternatives for treatment considered by the provider.

Implementation: Self-administered questionnaire for subjective ratings of StatRef by the care providers at the CRTS.

CIVIL MILITARY OPERATIONS DOCTRINE DEVELOPMENT (MONTEREY EVENT)

A USMC URBAN WARRIOR event will involve both military and civilian officials in a simulated biological terrorist incident in Monterey on March 13. A Civil Military Operations Center (CMOC) will be set up ashore. During this period, a small group in the Joint Medical

Center and a CMOC space aboard USS CORONADO will be developing civil-military doctrine for Navy support of such operations.

Hypothesis: Doctrine for managing a domestic Civil-Military operation through the CMOC can be developed.

Measure 1: Military and civilian officials involved in the doctrine development rate the operation as successful.

Implementation: The measure will be established by a questionnaire distributed to the participants by the Analysis Team at the conclusion of the Monterey portion of the exercise. A five-point scale will be provided for the respondents to indicate their degree of agreement with statements of the measures, along with subsidiary questions.

CONSEQUENCE MANAGEMENT OF TOXIC RELEASES

This experiment will be a CPX aboard USS CORONADO only while in San Francisco Bay. Two sabotage-induced toxic releases will be modeled with special software (CAPS) and expertise. Subject-matter experts located in the Afloat CMOC space will provide a synopsis of the possible results and evaluate the response of the staff.

Hypothesis: There are effective civil-military responses to the two toxic releases.

Measure 1: Military staff and civilian subject matter experts involved in the operation rate the operation as successful.

Measure 2: Military staff and civilian subject matter experts involved in the operation rate the information flow and response as timely.

Measure 3: Connectivity between the Afloat authorities and any remote participants is rated as successful.

Measure 4: Modeling to support the experiment was rated as successful.

Implementation: The measures will be established by a questionnaire distributed to the participants by the Analysis Team at the conclusion of the San Francisco portion of the exercise. A five-point scale will be provided for the respondents to indicate their degree of agreement with statements of the measures, along with subsidiary questions.

VIRTUAL WORK SPACE (VWS)

This experiment is to test the VWS as a tool to support coordination between the Joint Medical Center (JMC) and the CMOC space aboard USS CORONADO.

The VWS will be implemented by installation of cameras, microphones plus a projector on one wall of each of the spaces so that a virtual picture of what is happening in the other space is available to all the participants. The VWS will be tested in at least the two Phase 1 events described above.

Hypothesis: A Virtual WorkSpace can improve the coordination between the JMC and the CMOC.

Measure 1: The military and civilian officials / subject matter experts rate the VWS as successful.

Measure 2: The connectivity of the VWS is available at least 90% of the time the JMC and the CMOC are both functioning.

Measure 3: Discussion of classified information in the JMC does not hinder operation of the VWS.

Implementation: The measures will be established by a questionnaire distributed by the analysis team to the participants at the conclusion of the Monterey and San Francisco portions of the exercise. A five-point scale will be provided for the respondents to indicate their degree of agreement with statements of the measures, along with subsidiary questions. A log will be kept in the CMOC and JWS to record non-operation of the system.

The FBE-E Security Manager will approve the VWS set-up and a question concerning the effect will be given to the participants.

DATA COLLECTION FOR CASUALTY MANAGEMENT AND CIVIL MILITARY OPERATIONS

Observers should be in place in the Joint Medical Center during all three phases to ensure that operator logs are maintained and user questionnaires are distributed and retained. Since the assessments are largely subjective it is important that the proper personnel are identified and close to 100% of the questionnaires are completed. Evaluation forms for a standard set of features should be prepared for the usability of the various systems. More general evaluation questions may be necessary as well to solicit insights into improvements to the system as a whole.

B. MEASURES

MARITIME DOMINANCE COUNTERING ASYMMETRIC THREATS

Hypothesis 1: Combat swimmers can be detected by the Mobile Inshore Undersea Warfare Unit (MIUWU) and other swimmer detection systems and countered by coordinated operations of the Port Security Unit (PSU).

Measure 1: The percentage of trials in which swimmers are detected before reaching unit and estimated range at which detected. Modes of detection and confirmation and time to sort and declare threat should be recorded. Swimmer mode (surface, open circuit and closed circuit) and visibility conditions should be noted.

Measure 2: Time from detection to prosecution of detection by response force. This includes time to communicate to HVU and the PSU and time to alert and activate effective responses (weapon to bear on visually identified target at effective range).

Hypotheses 2: Attached mines can be located more quickly using a hand-held sonar.

Measure 1: Ratio of time to locate mines attached to ship with and without the sonar.

Measure 2: Usability of the hand-held sonar.

Hypothesis 3: Networked multi-sensor surveillance and response forces in layered defense can counter asymmetric small-boat attacks.

Measure 1: Ranges at which attacks are detected and at which they are declared threats.

Measure 2: Time to initiate coordinated response to potential (sometimes WMD) threat after threat is detected, engaged or device is planted (final event of sequence).

Measure 3: Perception of false alarms, fratricide and collateral damage risks.

Hypothesis 4: Networked multi-sensor surveillance and response forces in layered defense can counter attacks from personal watercraft (jet skis).

From an assessment standpoint this is the same as Hypothesis 3 so measures and implementation are the same as above. However the range and velocity may make it very difficult to respond in a timely manner.

Hypothesis 5: Networked multi-sensor surveillance and response forces in layered defense can counter night attacks on anchored HVU by covert rubber boat with SEA SHADOW drop-off. This is somewhere between swimmer attack and small boat attack in the importance of surprise.

Measure 1: Percentage of the attacks in which warning is given by the MIUWU.

Measure 2: Percentage of the attacks that are detected by the HVU.

Hypothesis 6: Networked multi-sensor surveillance and advanced detection and management systems can mitigate effects of asymmetric WMD attack from low, slow-flying aircraft.

Measure 1: Ranges at which attack is detected and at which it is declared threat.

Measure 2: Time to issue WMD warning.

Measure 3: Time to initiate coordinated response to potential WMD threat after detected, engaged or device planted (final event of sequence).

Hypothesis 7: Networked multi-sensor surveillance and response forces in layered defense can counter night attacks on the HVU anti-ship missiles launched from a truck which exits a known holding area and proceeds to a launching area in the hills above harbor. Tip-off may come from USMC recon patrol on watch above Concord NWS.

Measure 1: Percentage of times exit is detected.

Measure 2: Percentage of time truck is detected in logical launch position or condition before simulated launch.

Hypothesis 8: Intelligence Preparation of the Battlespace (IPB), advanced sensors and networked control of the PSU by the MIUWU will allow more effective positioning and employment of the PSU against the variety of asymmetric threats.

Measure 1: Ratio of time to reset protective grid using MIUWU control to time without reset control.

Measure 2: Ratio of detections with IPB to that without IPB.

NETWORK-CENTRIC UNDERSEA WARFARE (USW)

Hypothesis 1: A collaboratively developed area ASW search plan improves overall search effectiveness.

Measure 1: Ratio of the integrated, predicted probability of detection for the collaboratively developed plan over the aggregated predicted probabilities of detection of the independently developed search plans.

Measure 2: Responsiveness of collaborative planning to changes in conditions. Although responsiveness might differ from that of independent planning, these differences will be very condition and situation dependent.

Measure 3: Practicality of collaborative planning. This measure includes communication requirements, software incompatibilities, training difficulties etc.

Hypothesis 2: The use of identical, high-fidelity models and associated databases by all ASW participants improves the overall understanding of the overall search plan and individual sensor performance. Additionally, the use of a common model allows "drill-down" into the factors affecting performance.

Measure 1: Value added to the planning process and the ability to effectively employ sensors.

Hypothesis 3: Time integration of the tactical undersea picture provides additional significant information for all ASW echelons compared to the current real-time tactical picture alone.

Measures: This is an exploratory effort to identify the comparative Essential Elements of Information (EEI) and the insights that can be gained at different ASW echelons from the timeINTegrated picture. (i.e., derivation of operational patterns, etc.)

Hypothesis 4a: The undersea tactical picture provides sufficiently timely positional and operational information for BLUE Force submarines to safely enable dynamic Weapons Exclusion Zones around BLUE Force submarines.

Hypothesis 4b: An ASW Joint Engagement Zone (JEZ) will allow more successful prosecution of an adversary submarine than the current exclusive waterspace management policy protecting BLUE Force submarines. (Note the JEZ assumes a common tactical picture containing timely track information for BLUE Force submarines and reliable, real-time communications between BLUE Force submarines and the rest of the ASW forces.)

Measure 1: Percentage of time that the sub was outside of the dynamic Weapon Exclusion Zone under various conditions. Note that success threshold for this measure is very close to zero.

Measure 2: Ratio of percentage of detections converted to successful prosecutions in BLUE Force Submarine Operating Areas using the JEZ deconfliction method over the percentage for the traditional exclusive waterspace management method using NOTACK procedures.

Measure 3: Ratio of percentage of detections converted to successful prosecutions in BLUE Force Submarine Operation Areas using the JEZ deconfliction method with continuous, two-way communications to the submarine over the percentage for a modified JEZ deconfliction method with continuous, one-way receive only communications to the submarine.

Measure 4: Tactical impact of two-way communications with BLUE Force submarines through systems such as ACOMMS.

Hypothesis 5: The sensor network and contact management capabilities of the ASW network provides an improved ability to "finger-print" and conduct all source overt or covert tracking of high interest WHITE shipping in support of:

Area defense against covertly armed shipping,
Counter-proliferation operations,
Counter-narcotic or other counter-smuggling operations.

Measure 1: Percentage of correct target classifications, identifications and signature correlations.

Measure 2: Percentage of time the contact of interest was tracked while transiting the exercise/experiment area.

JOINT THEATRE AIR MISSILE DEFENSE

Hypothesis: The addition of information from civilian in-place systems can significantly improve the fused picture of air and surface conventional and asymmetric threats.

Measure 1: Range at which a low, slow-flying threat can be detected and tracked.

Measure 2: Range at which asymmetric surface threats can be detected.

Measure 3: Time of warning of launch or range at which asymmetric cruise missile can be detected and engaged.

Measure 4: Fraction of population warned of asymmetric threat.

PRECISION ENGAGEMENT

Hypothesis: Current weapons system targeting processes are disjointed and do not exploit available technologies. precision engagement is a resource-demanding endeavor that sacrifices execution speed for accuracy. Fbe-e will experiment with new technology and supporting tactics, techniques, and procedures (ttp) with the intent of improving integration among weapon systems and between operations and intelligence efforts. Such activity will result in improved speed and accuracy of the targeting, planning, and execution processes, and reduce requirements for restrikes. Airspace deconfliction resulting from flight path conflicts, weapon trajectories, weapons effects, friendly aircraft, and unmanned aerial vehicle (uav) flight are also problems that constrain the use of long-range weapons. Improved technology and new ttp explored in fbe-e may allow inefficient airspace procedures to be amended for greater weapons effectiveness.

CIVIL MILITARY OPERATIONS DOCTRINE DEVELOPMENT

Hypothesis: Doctrine for managing a domestic Civil-Military operation through the CMOC can be developed.

Measure 1: Military and civilian officials involved in the doctrine development rate the operation as successful.

CONSEQUENCE MANAGEMENT OF TOXIC RELEASE

Hypothesis: There are effective civil-military responses to the two toxic releases.

Measure 1: Military staff and civilian subject matter experts involved in the operation rate the operation as successful.

Measure 2: Military staff and civilian subject matter experts involved in the operation rate the information flow and response as timely.

Measure 3: Connectivity between the Afloat authorities and any remote participants is rated as successful.

Measure 4: Modeling to support the experiment was rated as successful.

VIRTUAL WORKSPACE

Hypothesis: A Virtual WorkSpace can improve the coordination between the JMC and the CMOC.

Measure 1: The military and civilian officials / subject matter experts rate the VWS as successful.

Measure 2: The connectivity of the VWS is available at least 90% of the time the JMC and the CMOC are both functioning.

Measure 3: Discussion of classified information in the JMC does not hinder operation of the VWS.

CASUALTY MANAGEMENT

COMPARISON OF CASUALTY PREDICTION & LOGISTICS MODELS MAT, FORCAS, SHIPCAS, AND CASEVAC (PRE-PHASE 1 AND PHASE 3)

Hypothesis: No single model contains all of the features desired for all sizes of operation but one stands out as most appropriated for the battalionSIzed operation.

Measure 1: Usability by a typical medical planner.

Measure 2: Process validity & consistency - inputs are appropriate and complete and match the output specificity. Outputs are easily translated into required actions such as triage, evacuation, re-supply etc.

Measure 3: Scalability - ability to represent a range of size of operations with at least face validity.

MEDICAL COLLABORATIVE LOGBOOK (MEDLOG) (PHASES 1-3)

Hypothesis: MedLog is a convenient system for theatre-level situational awareness and daily management.

Measure 1: Usability of MedLog.

MULTI-LINGUAL INTERVIEW SYSTEM (DOW) (PHASE 1)

Hypothesis: The DOW provides an acceptable medium for eliciting vital information from non-English speaking casualties when no local language capabilities are available.

Measure 1: Understandability of questions by the casualty.

Measure 2: Usability of the device by the operator.

INCIDENT WATCHBOARD (PHASE 1 AND 2)

Hypothesis: Incident Watchboard (IW) can raise the situational awareness during a crisis at multiple levels of decision-makers.

Measure 1: Usability of IW in the shipboard and ashore environments.

Measure 2: Impact or value-added by IW to decision-makers.

THEATRE MEDICAL CORE SYSTEM (TMCS) (PHASE 2 & 3)

Hypothesis 1: TMCS provides patient tracking on a near real-time basis and also summary OPORD Annex Q casualty management information.

Measure 1: Time to access patient location from higher echelons.

Measure 2: Accuracy of patient location.

Measure 3: Usability of TMCS.

Measure 4: Visibility of Annex Q information to participants.

MOBIL MEDICAL MONITOR V

Hypothesis: Semi-automatic collection and transmittal of physiological parameters from bedside will more speedily and accurately update local and higher level information systems.

Measure 1: Ratio of time to update patient status in TMCS from MeWS divided by usual time for recording and transmittal.

Measure 2: Usability of MeWS.

STATREF AS FIELD REFERENCE LIBRARY ON CD- ROM

Hypothesis: StatRef is an easy-to-use reference to the latest procedures and treatments.

Measure 1: Usability of StatRef in the military environment.

Measure 2: Breadth of alternatives for treatment considered by the provider.

C. CONCEPTS

ASYMMETRIC THREAT

Mission Concept: Operate in an urban littoral environment while countering asymmetric threats.

Operations Method: Employ a boat with specialized sensors and flexible command and control capability to protect against asymmetric threats in port, at offshore anchorage, or in other littoral areas.

Use response forces in a layered defense to include armed patrol boats and Explosive Ordnance Disposal units under the command of the specialized boat to increase speed of response and defensive posture.

Use real time intelligence, surveillance, and reconnaissance data to achieve greater battlespace situational awareness to improve speed of command.

System Solutions: Slice boat; MIUW Van

Technical Solutions: Swimmer detection system; Hand held sonar

NETWORK CENTRIC ANTISUBMARINE WARFARE

Mission Concept: Maritime dominance relies on the traditional air, surface and subsurface superiority in the battlespace.

Operations Methods: The employment of Network Centric ASW (NCASW) will improve the commanders ability to assess balance mission objectives with the risk imposed by adversary submarines.

System Solutions: Distributed Collaborative area search planning; JEZ/JAZ

Technical Solutions:

PRECISION ENGAGEMENT

Mission Concept: Operate in the littoral, provide Naval Fire Support to place munitions on designated targets in a time constrained environment.

Operations Method: Employ sensor to shooter continuum versus fixed and mobile targets.

Utilize Integration of imagery and targeting tools in support of reactive and deliberate targeting.

Integrate the use of four dimensional near real time deconfliction in the execution of precision engagement.

Conduct targeting and missile shots in a GPS jamming environment.

System Solutions: LAWS, DAMS, EFT, CCT, JSTARS, ADSI

Technical Solutions: ISAR P-3, Tactical UAV

FULL DIMENSION PROTECTION (FDP) - JOINT THEATRE AIR AND MISSILE DEFENSE (JTAMD)

Mission Concept: If an Expeditionary Force is operating ashore, then the commander responsible for defense of those forces should establish an FDP cell to provide a single point for force defense.

Operations Method: Linebacker, Ring of Fire, FDP Cell

System Solutions: AEGIS Cruiser, AEGIS DDG, LAWS, ADSI, DCP, COP, JICO, RP&C system

Technical Solutions: JSTARS, STALKER, UAV, MATT, CAST, AVENGER, COMPASS

INFORMATION SUPERIORITY

Mission Concept: Provide sufficient and reliable networking of communication information in the battlespace.

Operations Method: Naval Forces operating in the littoral will have access to signals previously unavailable to afloat sensors. The ability to monitor and report levels of activity about communications paths will enable command action to restore or enable connectivity and flow of information.

System Solutions: Naval Communication Network

Technical Solutions: SNIFFER

CASUALTY MANAGEMENT AND CIVIL MILITARY AFFAIRS

Mission Concept: Provide coordination between the military force and the domestic Civil-Military authorities to provide managed response to weapons of mass destruction as well as managing casualties in the operations area.

Operations Method: Operate in an urban littoral environment while conducting civil-military operations of a medical nature and provide military use of civilian medical facilities.

System Solutions: Medical Virtual Workspace, Casualty prediction and logistics models, Collaborative Medical Logbook, Multi-lingual Interview System, Incident Watchboard

Hardware Solutions: DOW, MAT, FORCAS, SHIPCAS, CASEVAC

D P-3 LOG

March 14, 1999
P-3(1)

. 0700	off the deck, checking in with deathstar, at 13500 feet, 22k fuel, sys go, wx down to 10000 to 12000feet.
. 0745	on station
. 0755	vectored by ATC setting up area 36 49N 12140W, 36 52 54N 121 44 48W check in with icepak, deathstar
. 0815	pioneer video feed to Deathstar
. 0816	fighting clouds
. 0831	convoy confirmed
. 0834	comms broken by cipher C.
. 0841	convoy in site / police car-left/ 2 rear/ 1 side/ left hand lane
. 0849	convoy possibly out of field regard-125R 40
. 0926	convoy visual 15nm 36 35 121 48 54 convoy on IRDS, not recorded
. 0938	complete looking for convoy
. 0948	36 49 N 122 01 13 W
. 0949	37 17 N 121 47 05 W
. 1008	37 23 33 N 122 01 13 W
. 1013	Track vehicle passenger targeting together with deathstar good good lock Radar aqh-4 bad/inop
. 1030	off sta
. 1110	land

March 14, 1999
P-3(2)

. 0910	TOFF Back door POS-Manteca Vortae alt heading Fuel: 6+00 2200Z offsta (4+20 onstat no ord.

. 0939 icepak,clear switch orange
. 0942 onsta solid layer 4500Ft,
. 0945 deathstar solid layer
watch dog wizard Glen Court
. 1000 convoy underway 10mics 1010L
SL 718 4000' 3003 -4c.
349 2 stats winds
. 1032 wizard reports
low flying flier 374918 NE
from wizard 122245200 140T
. 1044 37500 N
122 24 00 W low flyer
using SAR for streaks on PTG
at 18,000 14-16 miles affect
res: 2 strip map
3-3,500'
. 1102 report ps normal high speed target
S SW of Alcatraz, unable
Class by
ALL TEAC reorders fail...3 total,
3746N low slow, 1223100W
. 1129 report to Deathstar combatant poss
going under golden gate high
speed target west Teasure Island
. 1150 small attack in progress
N 374909 340 stats 2
1272423W
. 1208 SAR locked up
374952N
1222535W no T 25 2
no tasking from Deathstar move to EA I Z move East
EA Q 37-53 OCN EAI
122-18W
37-51IN EAQ
122-17W
37-33N 37-33 29N
122 37W 122-152W
. 1230 repositioning
. 1232 convoy richmond marina
37 56 N Richmond Marina
122 23 22 W
. 1243 looking Richmond marina
375438N searching
1222229W
. 1310 no joy

. 1315 37250398N
1221824.24W HWY 80
stationary or side road found target
. 1323 found target
3753N 122-15W

	have convoy stationary target on move out clouds, HWY 80S
. 1335	lost due to repos.aircraft
	W3752.54
	1221853
. 1350	3751.6
	12219.8
. 1355	relocated convoy on pier
	Berkley Pier stationary

15 MAR 99
P-3(1)

. 1100	Take off time
. 1121	On station back door / posit, alt, heading 34K 7 hrs; no orders; onsta 1700L looking toward deathstar
. 1128	Check icepak SW deathstar
. 1140	Unable to check deathstar; solid layer 2000 over Moffett; GCS own discretion black X pier 35; SP point I in slice with jacket
. 1201	No joy 4850; on cell phone moving to fast for reception
. 1215	Deathstar man aloft-no C possible pioneer met with the slice boat; no joy on target GCS looking
.1226	record Moffett, record hanger - time for 30 sec.
. 1238	101 best target path UHAUL truck X-24 ft. length; Pioneer 8.5 ft. Pioneer limited by stab(roll) of slice boat 020 P abecm
. 1255	neg. blockbuster UHF/HF; looking for needle haystack OT CCXS up
. 1319	changed track to 11 HWY 101
. 1330	repos Moffett net with Deathstar convoy not leaving Moffett until 1330
. 1342	Slice boat N 1332L / 3731 o2N UAV posit / 122 1026W
. 1347	constrained by Airspace tract
. 1353	aircrft recorded Ed
. 1358	373537
. 1401	in for 1222214W / time for 60 sec. / 98% maneuvering to reset due to short for and airspace

16 MAR 99
P-3(1)

.1000	Take off / backdoor, check repak, 11SOB, Travis, no order, FL heading, Deathstar
. 1024	Check in back door switch Deathstar / -1 16000 200 cloud stratus
. 1027	winds 196146kts 381045N 1222221W
. 1030	On station
. 1038	Go with knee board card
. 1039	OTCIES up
. 1045	Good pioneer 4850 / reversing track CCW
. 1050	Copying STYX (exorcet elint parameters negative on info, info not available cannot pass from CCDR Huntocn PTR, Emery, Berkeley
. 1103	1/2 ~ m N
. 1106	flying N/S tracks, Coast Guard anchorage 7, Boston whaler anchorage 7 3749.5N 12223.5W
. 1125	can switch to IRDS video
. 1125	no joy SAR/AUX-1, AUX-1 obscured by clouds / SW Yurba Buena

. 1133	radar masts off on boat red force, Boston whaler, radar center blue force, VTR 1 working again after clearing 180ft. NNW C
. 1138	using IRDs for pioneet feed ancourage 7
. 1147	
. 1152	Boston whaler aft SLICE boat
. 1157	ELNE Alcatraz, found ferry moving towards it
. 1200	resume surveillance / Write grip or cleaning mirrors 120 lense
. 1220	3747.53N 12221.40W SS, looking for sea shadow
. 1222	SS 37-48N 12218W 5kts. 030T
. 1226	Yerba Buena TI to hid 8min. for max on current track / 3748.40N 12221W
. 1233	37 49N 122-21W red 3 high speed targets 20kts. 250T
. 1235	slow down 3748 33N
. 1236	friendly interest 12221W target
. 1243	trackone 2 high speed chased by 1 more 3749N 12221W 3 Boston whaler together East Treasure Island/Anchorage 7
. 1250	target peirside
. 1256	3748N 12222W image etcs.
. 1302	IR saw helo lift 3750N 12217W off Bonne Homar Richard LPD DIW
. 1303	tracking helo follow airfields
. 1304	1. Half Moon Bay 3731.0N 122360W
	2. Marine 3801N 12231W
	3. Grosse 3808.5N 12233.0W
	4. Concord 3800N 12203.5W
	5. Palo Alto 3727.5N 12207W
VLAD	1. Half Moon Bay
	2. Marine
	3. Gross
	4. Concord
	5. Palo Alto
	high blue strip sea plane single engine
. 1335	sans. N.PTG on water plan pass TOI not target commodore
	6. commodore winds 186150
. 1340	Concord
. 1348	Half Moon Bay
. 1349	seaplane - no activity Palo Alto, Marine no activity
. 1403	no image commodore / Half Moon Bay
. 1419	coming up to Commodore
. 1429	blowoff Concord go to Commodore/Half Moon Bay
. 1450	seaplane on pier commander
. 1500	no activity at Plo Alto seaplane
. 1507	3751N 12227W seaplane heading 300 TOO'
. 1511	37 53N low flyer / 12224W floating land
. 1520	require 3750N 12214W 050T
. 1530	backdoor RTB / offsta RTB
. 1550	Land

17 MAR 99

P-3(1)

. 1000	Take off / TMS due to power shifts outage
. 1030	onsta - boat load temp. suspended my MPP(s) matt good b TCIXS 1022L

TMS keyset of OASIS.ODS inputs to OAIS at NAV/TACCO station tried with TIBS RCV1and no tibs ice pak fuel statw 9+00, back door 200

. 1036 FL180 check in incepak

. 1040 next on track 1, must remain by ATC

. 1045 container vesc NYK-VEGA, black Hull NYK on side white SJ, dark streak, red lights all stripes 3237.3N 117=14.7W, entr. Golden Gate Bridge

. 1107 blockbuster sweet

. 1110 3745N 12251.5W ship posit.

. 1123 primary sensor on Emery will Marine

. 1131 freedom navigate in Track

. 1137 cus spd COI VEGA / 3745N 12230W 050112 / pos. 3746.09N Oak Knoll 1220843W protest / 3149N 12222.44W

. 1205 jet ski along shore ships to clutter for Radar ISAR

. 1210 Treasure Island jet skies

. 1212 37560822W 122275997W

. 1214 Oak Knoll

. 1217 people on front

. 1221 ship 37-51-41 1224621W

. 1225 name verified N'

. 1228 conformed PANAMA on ship

. 1234 ship broke in mership guide

. 1240 container cont M APL 3803308N MSMF 122-2943W

1. 3752.4N UC Berkeley
2. 37.48 on Oak Center Hall

122-16.32W

french/obs radical prot / new tracking ptR ptB / I80/580 2 24" UHAUL

. 1305 05 FAM complete PTC 380200N industrial

. 1350 12200C/W plain white looking for truck found by UA 40

. 1400 track constraint orbit circle is choice-track 2 NE airfall east storage

. 1407 vehicle parked 1/4 mi N4 38-10N 12203W posit in track 2, still inhabited by lack of orbit

. 1415 on move (truck) time for FOR 1438L in FOR

. 1500 6 min. FOR PT Richmond circling enalve looking at several angles increasing prob. Of detection, xxxxxxxxx on target area

. 1520 375690N 12203 59W looking 37 57 12203.4W

. 1531 found trucks heading west on HWY 24 375749N

. 1542 trucks pull 12204N over to side-required after repos due to track

. 1545 trucks stationary, 1 vehicle behind part of exercises, other two not

. 1549 vehicles on move 3754 23W 12209 32W

. 1554 vehicle split, trail vehicle-stopped 28dec. 304JB orbit 6.7 37:52:28N

. 1558 on move again 122-10:44W

. 1603 tracks in tunnel

. 1604 out of tunnel space shuttle on side of truck

. 1608 received 15 opnotes, VG jam system

. 1609 580 West to Bay Bridge

. 1614 lost cte due to repos aircraft

. 1621 found Pelican target, moving down road

. 1631 found target at pier parking lot / 374836N 1225539W

. 1633 reqcquired targets 122-19W 3751N / 3500MHZ

. 1641 reacquired target

. 1644 tracking algorithm working

. 1655	offsta
. 1656	chipped with Icepak
. 1720	Land

E ASYMMETRIC LOG

Asymmetric Threat Events Log
(All Times Are Local Unless Otherwise Noted)

15 March 99

(Comms checks, etc.)

0100 Explosive Ordnance Disposal Mobile Unit 11, forward stationed aboard United States Coast Guard Station, San Francisco, Yerba Buena Island for the duration of Fleet Battle Experiment Echo. Tactical control maintained by Mobile Inshore Undersea Warfare Unit 105. Operational control maintained by Commander Amphibious Squadron 5. Detachments 55 and 64 are aboard.

0805 EOD 11 attempted comms with MIUW (LP257A), no joy, standing by.

0840 EOD 11 established HF plain communication with MIUW.

0850 EOD 11 established HF encrypted communications with MIUW.

0920 MIUW 105 underway from USCG Alameda, RSSC is embarked on board Slice Boat. Destination: San Francisco Bay area. Mobile sensor platform is embarked on Slice Boat for FBE –E. Radar input up from Slice Boat, Sonar up, Radio comms up, MIUW control, boat control, MIUW safety C&R, GCCS down due to hard drive failure.

0945 EOD 11 -Still no joy LP258A and LP258B. Hearing traffic but no connect.

0955 Slice proceeding to Anchorage 7.

1148 Good image from EOD Det 31 (WMD Cell) aboard USS Coronado to EOD 11.

1445 EOD 11 received information on two vans from MIUW 105. Transmission garbled. *(Note: This was a Precision Engagement Event.)*

1520 Deployed Det 55 to Pier 35 to respond to possible IEDs in two suspicious vans.

1540 MIUW 105 reports possible swimmer attack against USS Coronado. *(Note: This is a false alarm. The swimmer event did not start until 1700.)*

1550 MIUW 105 called halt to swimmer attack-ex. Coronado requesting HTCM (MDV).

1555 EOD 11 communicating with Det 55 via cell-phone. "No Joy" utilizing VHF LO.

1610 Slice arrives Pier 35.

1613 EOD 11 comms made Det 55 with manpack, ckt EOD 911M1 VHF LOW.

1614 EOD 11 comms made with MIUW, ckt LP257A.

1615 Power lost on YBI. EOD 11 operating from generator.

(1700-2000U Combat Swimmer Event. Participants: USS Coronado, Seal Team 1, MIUW105 embarked aboard Slice boat, PSU 311, EOD.)

1705 MIUW setup grid with USCG Long Island.

1710 MIUW setup OPS with PSU 311. PSU reports OPFOR boat within 300 yards of Pier 35.

1715 PSU reports 1 person may have gone overboard from OPFOR boat.

1717 Slice underway from pier 35. OPFOR boat heading North.

1720 EOD TAO (RSSC) in contact with EOD Det.

1730 EOD divers on standby, Yerba Buena Island.

1745 MIUW over-under voltage relay tripped main circuit breaker.

1750 MIUW completed emergency shutdown of RSSC.

1820 MIUW Van Power-up complete.

1845 MIUW comms with USS Coronado up. C and R circuit.

1847 MIUW comms USS Coronado down C&R circuit. Will check in at 0700U for radio checks.

1920 Swimmer detection reported from USS Coronado. (*Note: Seal Team 1 reported to Coronado, mission complete. Eight limpet mines deployed.)*

1924 Request hull search of USS Coronado by EOD.

1925 EOD commenced diving operations.

1939 2 EOD divers commenced surface swim for USS Coronado hull inspection.

1946 Secured PSU boats.

1955 EOD divers completed surface search of USS Coronado. Report nothing found. Submerged search in progress.

2028 Fleet Control Reported all OPFOR divers recovered safely.

2050 Fleet notified EOD TAO that they were requesting permission to bring out their divers due to excessive currents and re-insert at 2345U.

2109 Securing from exercise.

16 March 99

0700 EOD 11 Communications watch set. Established HF w/MIUW. Set up MB16, C and R, EOD TAC, VHF, EOD TAC Saber.

0715 EOD 11 RCVD SAT assignment from MIUW: Bird 172E 297.225 offset 5… setting up.

0923 EOD 11 reports good UHF check Cutter Long Island C & R 381.75.

0945 Chief calls CG from MIUW. MIUW can hear Fleet control but they can't hear MIUW. Contact made with CG Long Island. Acting as intermediary.

0950 MIUW asked to contact Coronado by cell phone. No good numbers immediately known.

0951 UAV Video finds small boats near bridge, coming from back of Treasure Island.

0953 Chief sends CG to investigate. Cutter Long Island goes. Chief asks CG to let Coronado know multiple crafts: PBR moving toward pier 35. 4 PSUs, 3 CG rib boats, 3 CG auxill.

0958 MIUW radio out, can't contact Coronado.

(1000-1300U HSMST Covey Attack Event. Participants: USS Coronado, MIUW105, PSU311, EOD, SBU122, USCGC Long Island.)

(1000-1300U Truck Anti-Ship Missile Event. Participants: USS Coronado, UAV, Naval Reserves (driving U-Haul trucks), USS Port Royal.)

(1000-1300U Low Slow Flyer Event. Participants: USS Coronado, USS Port Royal, Cessna-172.)

1004 GPS in MIUW not working.

1006 OPFOR boats reported inbound from Golden Gate, about 1 1/2 miles.

1009 Four high speed boats inbound to Pier 35 via Alcatraz.

1012 MIUW declares all inbound boats as threats. Sr. Chief asks CG to stay in position.

1026 Sr. chief aboard MIUW asks to get control of Pelican *(UAV)*.

1037 Slice lookout reports sea plane inbound, over CG bridge.

1039 2 High speed threats from Alcatraz to Coronado. CG intercepting.

1040 3rd High speed boat stopped. CG asked for cover.

1042 4th high speed boat sighted by MIUW along coastline, an SBU. Low flying aircraft sighted.

1043 Sea plane in water by Coronado.

1045 Sea plane traveling down side of Coronado.

1047 MIUW takes control of UAV.

1047 Another inbound boat. Commercial. Watchdog identified as full defense protection on Coronado. ***(Note: Watchdog is MIUW TAO.)***

1058 2 Jet skis off Baker Island.

1108 UAV can only see tops of clouds.

1110 Sea plane goes near Coronado two orange boats in sight. One is enemy, one is safety observer.

1129 Report of decoys by Bay Bridge.

1121 Slice forward lookout spots plane and relays to MIUW.

1125 Another sea plane buzzes MIUW, then leaves. Another approached but turned. A third one came near MIUW, then headed for Coronado. *(Note: A commercial sea plane was giving harbor tours from the pier 35 area. This plane was often identified as a low slow flyer although it was an unintended participant in the experiment.)*

1128 Seaplane goes out to Bay Bridges, then approaches Coronado and lands.

1130 High speed boats appear off Alcatraz, then go back behind Island. Believed to be a diversion. Sea plane gone. EOD 11 notified SFVTS DET 31 to commence diving operations alongside USS Coronado. *(Note: This is to recover limpet mines from 15 March Combat Swimmer Event.)*

1136 PSU and 3 SBUs inbound from Alcatraz, also one SBU from Pier 33 and a small red boat.

1139 All repelled by 50 cal fire-five boats, CG and PSU.

1140 EOD DET 31A is onboard the USS Coronado, established comms.

1142 2 Cobras inbound, heading 010, under Bay Bridge, circle around.

1203 Slice lookout reports high speed boat at heading 270.

1215 Multiple boats incoming, 4 from different directions. Another from behind makes 5. Repelled.

1220 EOD DET31 divers have splashed.

1228 MIUW reports finally good UAV feed. PSU reports DIW OPFOR vessel to EOD. Currently investigating.

1237 Return attack spotted by forward observers aboard PSUs. OPFOR goes close to the dock and follow along edge of bay.

1250 EOD is requested to respond to disables vessel with possible explosives.

1251 Cessna flies overhead.

1305 EOD enroute from Yerba Buena Island.

1318 EOD is on scene of disabled vessel with possible explosives.

1323 EOD boards suspected/disabled vessel.

1324 EOD has located possible Mustard Gas on the disabled vessel. EOD request to evacuate the area within 2000 yards from disabled vessel. Slice boat repositions 2000 yards up-wind from vessel.

1330 UAV Pelican secures.

1350 EOD Det 31 still conducting limpet dive on Coronado. Det 55 reviewing safe procedure and attempting reachback on WMD.

1400 EOD Det 31 reports four devices have been removed from the hull of the Coronado.

1405 EOD Det 55 reports status of WMD. Agent is Mustard Gas. Potential release of agent. Winds NorthWest at 10knts. DownWind hazard 1.2 km. Cloud Width 80meters. X-ray results negative.

1410 Watchdog reports possible weapons launch. Heading 055T from Port Royal. Possible WMD 53 09 03 N 117 55 W. Missile launch: Oakland point of impact.

1411 TU 2055 – Splash.

1415 Slice arrives Pier 35.

2015 Slice underway from Pier 35.

2025 PSUs report all boats on station.

(2100-2300U Combat Swimmer Attack Event. Participants: USS Port Royal @ Anchorage 7, Seal Team 1, MIUW105, PSU311, EOD.) (Note: This was an unscheduled event. Seal Team had requested an additional dive. This was to run concurrent with the Covert Rubber Raft Event but the event was rescheduled due to mechanical problems with the launch vehicle.)

2220 PSUs simulated launching concussion grenades in defense of combat swimmers.

2315 FinEx.

17 March 99

0600 MIUW 105 underway from pier.

(1000-1100U Single Jet Ski Attack Event. Participants: USS John Paul Jones, MIUW105, PSU311, SBU122, EODMU11, USCGC Long Island.)

1005 Slice lookout reports inbound Jet Ski. Range 1000yds.

1011 UAV reports will not be on station until 1100.

1012 Jet ski investigated and is not hostile.

1055 UAV on station.

1059 MIUW lookout reports 2 Jet skis in vicinity of tanker Long-Beach. One inbound toward John Paul Jones from the North and 2nd Jet Ski inbound south of John Paul Jones.

1100 PSU raider boat engaging jet skis.

(1100-1400U Covey Jet Ski Attack Event. Participants: USS John Paul Jones, MIUW105, PSU311, SBU122, EODMU11, USCGC Long Island.

1145 4 Jet skis commencing high speed run on John Paul Jones, PSU's engaging.

1153 UAV reports 4 Jet skis are at 37 49 40' N 122 22' 44' W.

1159 UAV reports 4 Jet Ski are at 37' 49' 40' N 122 22' 44' W.

1209 2 Jet Skis make high speed run on John Paul Jones.

1210 Slice underway to station 1000yds. North of pier 35.

1215 2 Jet skis' inbound to John Paul Jones.

1216 Jet skis circling John Paul Jones.

1219 NYK Vega under Golden Gate – UAV reports 4 Jets on beach between Yerba Buena and Treasure Islands.

1232 4 Jet skis making a run on John Paul Jones. PSU's engaging.

1300 Finex.

1320 Slice arrives Pier 35.

(1400-1700U Truck Anti-Ship Missile Event. Participants: USS Coronado, UAV, Naval Reserves (drivers for U-Haul trucks, USS Port Royal.)

1630 Slice underway from pier 35, San Francisco Bay.

(1700-2000U Combat Swimmer Attack Event. Participants: USS Coronado, Seal Team 1, MIUW105, PSU311, EOD.)

(1700-2000U Combat Rubber Raft Event. Participants: USS John Paul Jones, Seal Team, MIUW105, PSU311, USCGC Long Island, Sea Shadow.)

1732 USS John Paul Jones reports sighting Sea Shadow.

1735 PSU engaging rubber raiding craft aft of John Paul Jones.

1736 Slice Aft lookout made visual contact of Sea Shadow.

1745 Slice at Pier 35

1805 Slice is underway.

1830 PSU engaging OPFOR off Pier 35.

1835 MIUW reports to EOD that USS Coronado is under small boat attack. EOD DET 55 and 31 are on standby.

1838 MUIW requests EOD support. USS Coronado reports bubbles towards hull.

1840 PSU observed bubbles in water near Coronado, PSU engaging swimmers

1843 Long Island engaging OPFOR Boat off pier.

1844 PSU observes bubbles.

1845 USS Coronado reports bubbles on port quarter.

1847 PSU reports bubbles in water off Coronado port quarter heading East. EOD Det. 31 is underway with two MK V's and one RHIB.

1855 EOD boats departed.

1901 Slice receiving UAV imagery.

1903 EOD Det 55 is underway in ground transportation.

1917 EOD Det. 55 is on station at Coronado.

1935 EOD Det. 55 has surface swimmers starboard side Coronado.

1946 EOD complete hull and pier survey on Coronado.

1947 PSU engaging OPFOR near John Paul Jones.

1952 EOD Det.55 reports surface swim completed, nothing found. Informed MIUW.

2000 FINEX of combat swimmer exercise.

2020 EOD diving Ops on hold due to equipment causality on Coronado.

2021 Slice lookouts have visual contact of Sea Shadow.

2023 Slice has Sea Shadow on TIS. Started VCR #1.

2024 EOD divers commenced under hull survey of USS Coronado.

2030 EOD divers found Mk48 limpet, frame 242, depth 20ft, quick step has been performed.

2041 Finex of combat rubber raider craft exercise.

2058 EOD Det. 55 reports 60% of stern has been searched.

2115 Slice arrives Pier 35, San Francisco.

2147 EOD Det. 55 divers are on the surface. Diving ops are secured due to current.

2148 Liaison with Coronado to complete limpet recovery tomorrow.

2237 EOD Det. 55 returns to base camp.

18 March 99

1053 USCGC Long Island Posit 37 – 49.0 N 122 – 22.6

(1100-1400U HSMST Covey Attack Event. Participants: USCGC Long Island, MIUW105, PSU311, EOD, SBU122, USS Coronado.)

1100 Slice Boat underway from Pier 35, San Francisco Bay harbor. Transiting to anchorage 7 for Fleet Battle Experiment Echo operations.

1133 GDFS in MIUW van is locked up. Three attack boats coming in from the North to Long Island position and one inbound from the South – PSU's engaging. *(Note: USCGC Long Island acted as High Value Unit during this event.)*

1141 MIUW GDFS is non functional.

1146 Slice sonar is secured. Sonar buoys are dead in the water.

1201 CG PSU's boat are reporting unsafe boating tactics by SBU boats. SBU's are not giving way and are closing within 10 ft.

1202 Death Star took control of UAV. *(Note: Death Star is the USS Coronado. There* *were multiple events occurring in addition to Asymmetric Threats and the UAV was a shared asset.)*

1212 MIUW regained control of UAV.

1237 Long Island under attack by small boats.

1240 Slice repositioning to 2000 yds West of USCG Long Island. PSU boat positioned shoreward side of the high value asset.

1258 Helos launched from the USS Bon Homme Richard. Notional playmate

1300 Slice has returned to sector search.

1302 HDC has instructed UAV to return to base. UAV watch station going offline.

1315 Three small boats attacking HVU from the North, being intercepted by PSU.

1321 A Samsonite suitcase was found to the stern of the HVU in the water by PSU craft. PSU towed the suitcase to a position 500 yds Southwest of HVU.

1327 Notified Watchdog of unidentified suitcase found on a vessel.

1329 Position of Slice relocating South to take station area of Blossum Rock.

1331 Notified Watchdog of intentions to tow vessel with suitcase out to sea.

1338 EOD is on scene of suspect suitcase.

1342 Advise Watchdog that EOD will notionally tow suspect craft with suitcase out to sea.

1344 Finex exercise.

1411 Slice arrives at Pier 35.

(1500-1800 Low Slow Flyer Event. Participants: USS Coronado, Cessna-172.)

1500 Slice underway from pier 35

1505 PUB intentions completed all PUBS accounted for.

1530 Slice arrives Pier 35. Asymmetric Threat Events complete.

F FULL DIMENSION PROTECTION LOG

Full Dimension Protection Compiled Collaborative Log

13 March

15 March

0831
Today, DCP session with PRYL. PRYL didn't get good IPB during Northern Edge. Our challenge is, since there is no dedicated J2 for FBE-E, is to generate a believable, challenging, IPB to support PRYL planning for air and space defense. What we are passing them during 15-Mar IDP follows:
Probable Cruise Missiles origins, routes, and probable launch sites.

Additionally pass them probable airfields that are related to low slow flyer launch.
Work on CAPS to increase DAL, include Sacramento and Marian Co. This should force PRYL to discuss Patriot requirements and positions with SMDBL and then come to CJTF with a formal request for additional defense assets. FDP commander with force them to show justification using CAPS displaying DAL laydown Vs. SM-2 BLK-IVA and Patriot (PAC-3), will task them to show justification by 16-Mar and recommendations for TPFFD modification.

Need to know what additional assets required from CINC to cover expanded DAL.
SMDBL will be tasked in DCP session to provide detailed documentation on Avenger capabilities and limitations. Additionally, FDP commander will visit Avenger unit to discuss best use with Army commander and USMC expeditionary commander.

JICO currently at the MLV at Golden Gate to debrief link status with FDP commander on board Coronado today. A key issue is to get the JICO linked up with JSTARS link technicians in FL to ensure JSTARS link connectivity on the 16th.

Jet ski pre exercise (17-Mar) info in, good comm stuff. Key issue with jet ski with all surface surveillance is that Slice boat has no link capability (even their JMCIS is down), FDP cell will be their eyes and ears and task slice boat and their assets by Hot Vector.

For every MSEL event, need the launch time.

1039
Orange launched two test missiles to intimidate green. three space systems each detected the launch and reported individually over stred. Individual tracks were received for both launch vehicle and impact points. FDP CDR used space warning to make warning over network to not only military but also through CMOC and Medical to warn city. Key C2 item during launch was that because the impact prediction for space warning is so inaccurate a large illipse was generated by spacecom that actually not only showed impact in water but showed missile could have impacted land north of city.

Key...In that we did not have visibility of either AEGIS tracks of BM's which will give a much more accurate prediction of launch and impact. Over cmd net FDP cdr assessed impacts over water engaged holdfire on both launches. Other C2 issues JMCIS which does correlate different inputs from space did not receive and display and that ? need to investigate. Issue

ADSI tracks received from space should also be rebroadcast so that non-tre or trap capable units can see space predictions. Confirmed with JPJ that they did not receive them.

ISSUE
LAWS did not receive launch or impact points. Intent is to hook launch points in LAWS and schedule for targets in PE cell immediately after it is determined that impact points are in green territory. ISSUE is that tracks need to displayed on LAWS from ADSI, track numbers on ADSI are not correlating with LAWS track numbers..
All units need to launch DTT's for all MSEL events. What this should show is 4 sourcesa for scud launches JNTF, PRL, JPJ and SSC SD sim. Once Coronado is up Link 16 and we are able to receive PRL, JPJ and SSC tracks need to ensure ADC conducts manual correlation of multiple tracks so only one vehicle is engaged. Contact PRL to ensure they are able to manually corellate. Intent to bring Patriot assets into scenario.

Discussion on Patriots. Recently met with city officials and it is apparent that the extent of defense will require CJTF to bring in additional air defense assets. Based on the request, location of additional defended assets, Patriot will be required. PRL has been passed this additional requirement via compass and will reenforce in the intentions message to have them prepare new defense diagram in CAPS.

1048
Met with fleet surgeon who is the focal point for CMOC for connectivity with civilian officials. Fleet medical well equipped with C4I, including three radio terminals. It is imperative that fleet medical be up on FDP command net to ensure he can receive timely warning from FDP cell and then relay to Govenor's office of emergency services. Briefed current defended asset list and will meet with gov's office am 16-Mar to determine modifications to support civilian desires for defense. Additionally discussed the intel on orange and FLA plans to move sarin chemicals via truck from outside the city to somewhere inside the city. Concern that requires CJTF level decision is the issue of terminating the vehicle prior to arrival in San Francisco. This is a FDP cell, PE cell, WMD cell, CMOC, and medical decision. Intent is to get a WMD cell best guess at proliferation following attack and attempt to obtain route from intel sources, and then try to select the least harmful point on the route to destroy the truck. Force medical feels that intel's assessment on the amount of sarin is inaccurate and should be reverified. We'll meet with the PE cell at 1100 to close the loop on planning and have already scheduled use of FDP cell tools such as Stalker, LAWS, EDGE to track and predict truck movements to support PE and medical coordinated strike.

1055
Additionally offered CMOC/City officials use of mobile US Army air defense unit Avenger for city use in providing additional downtown defense (Avenger can only be used against air breathing threat, not TBM). During meeting on 16-Mar, we'll confirm with Gov's office DAL, probability of defense against ballistic missile, and vulnerabilities from both sea-based or land-based FLA (insurgent) forces.

Medical advised FDP cell that they had been receiving warnings via surenet and this was too slow. We confirmed that the pipe that surenet is using was only experimental and was too small, and that the primary method of warning which should be very timely would be via voice net (FDP command net ch 57). Using combination of ADSI and EDGE, FDP cell will provide first a mesoscopic warning followed by a microscopic warning. The scale we're dealing with here is that the first report should be able to provide them with an impact area of a 3-5 nm elipse and once the track could be displayed on EDGE, we would provide them a centroid prediction down to a street corner.

1055
Medical call sign is Big Dipper.

1338
Status of the link is, because of linebacker's unique capabilities, he has a multi freq link capability, UHF and VHF on Port Royal.

The multi link van is up. They receive HF.

We have link 16 with Avenger and Bon Homme Richard. Network problems with JPJ.

1415
Channel 57 was to be used to communicate with the Joint Medical Center. When JMC gets on the channel, they're told that it is for ship to shore movement and that they shouldn't be on it. We are back to ship's phones to communicate with them, or sneaker net.

1405
Additionally we're now getting P-3 and UAV video coming on the convoy. We're tracking a convoy with chemical weapons. Decison is going to be made by the commander to hit the convoy or attack the convoy without releasing chemical munitions. The IW stated that the convoy was heading to Pier 35 (the Coronado). Right now we have several vehicles tracking.

1410
JPJ just reported comms with the PRYL is up in linebacker mode. Based on I&W JPJ is up on NTDC mode.

1420
MIUWU boat called in. Reported two UAV contacts headed toward Coronado. Position 37'34'32" N 122'19'28" W. MIUW lost power to their van, so they called over the phone.

1430
Second fireball. Single salvo from Fallon area received IW both TRAP into ADSI and into JMCIS. JMCIS correlator operated correctly. Went out with voice warnings on surface defense net since Battle group command net down. The warning was passed to the city via JMC at time 1432 once the impact area was determined to be off the coast and no threat.

Additionally, right before launch, Slice boat reported two possible surface contacts carrying possible WMD. Allerted WMD cell. Crew tracked using slice boat. Negative comms between FDP commander and Slice boat. Slice autonomous. Awaiting report from Slice on nature of threat from two craft.

1535

Directed that information be passed to MIUW of IW of swimmers in vicinity of Coronado.

1530
FDP met with WMD cell to discuss impact of intercept ballistic missile carrying chemical weapons. WMD cell developed plots for expected plume if a scud was intercepted at 40 k, 60 k, 80 k, 100 k, and 140 k. Plots indicate that it is best to intercept above 60 k, because of direction, and whether plume drifts over water. Plots will be sent to Port Royal to help develop TMD autodoctrine to help engage ballistic missiles at optimum position. We do not want to intercept beyond the FAT part of the window, so Port Royal will have to take a look at not trying to intercept the missile too far out, and accept a lower pk, but intercept between 60 and 80 k to be able to engage in support of lowest lethality of CW. Port Royal has the capability to run intercept models using dynamic test targets. FDP will task them to do this and evaluate engagement strategy during DCP session 16-Mar.

1555
Report from MIUWU regarding boats to protect Coronado at Pier 35. SBU was required to go off station to refuel. Consider this unsatisfactory in that Coronado is defenseless to small boat or swimmer attack. MIUWU, as scene of action commander, must manage both EOD and SBU assets to support 24 hour coverage with boats. Slice boat supporting MIUW sustained casualty to navigation system and is not able to maintain harbor defense for FDP commander as tasked. Until Slice is operational, JPJ will be tasked to support harbor defense from anchorage 7.

1603 - From CPR5N2: What real-world impact will occur on JPJ by having her provide harbor defense from anchorage?

1600
FDP contacted slice boat to report possible attack swimmer threat to Coronado (HVU). the miuw unit onboard the slice boat acting as harbor defense control initiated / activated the port security unit (PSU) to provide a layered defense of the HVU. The PSU maintained a layered defense posture around the HVU using two small boats to patrol the area immediately around the HVU.

1645
From FDP commander to CPR5 N2 and N3: In response to question of 1603. Intent was to have all ships either at anchor or underway maintain a surface and air watch during the 0600 to 1800 time period daily in support of FBE-Echo. Intent is to build an accurate air and surface picture with sensors and then link. We need to make sure all ATF units are up on both surface sensors link and ATF command UHF net with COMTHIRDFLT, call sign Watchdog from 0700 to 1800 daily. Your support is appreciated.

16 March

0735
Morning Meeting

Avenger guys with us today.

Port Royal won't be able to cover the extended defended asset list. This should result in a request for more Army support, Patriot or Avenger. They'll discuss the needs in the two-hour FDP meeting this morning.

0830
Correction, two-hour FDP meeting should be DCP (Distributed Collaborative Planning) meeting.

Morning meeting, cont: The Avenger batteries are on link 16 and are communicating through the JICO, currently. The air defense commander may take direct control of the Avenger units. The possibility of staging the Avengers on Treasure Island to improve coverage of the anchorages and DAL was discussed. The Avenger personnel also received a scenario briefing with emphasis on their role in the overall picture. Their means for requesting additional protection was discussed.

The Avenger Batteries will participate in this DCP meeting to discuss optimal placement of their firing units and the Sentinel radars.

0840
JPJ reports turnover of situational awareness and patterning in the Bay Area with Port Royal. Port Royal will be at anchor at 1000. Watchdog has good comms with the JPJ and PRL.
Since the start of the experiment, the JMCISS setup hasn't allowed the experiment staff to change the classifications or ID on the JMCISS air picture. The Third Fleet Staff can change things from their command center, but not the experiment staff. They're working on the fix now.

0914
The DCP event did not go down on time. PR working the collaborative plan to include SHORAD unit.

0916
Received word from PR that it can cover almost all of DAL. Exception is Sacramento, they request Patriot coverage for Sacramento.

0920
The VTS reports small aircraft in vicinity of anchorage 7.

0924
JMCISS won't allow sim tracks to be merged.

0925
JPJ reports Orange launched ballistic missile, launch track number 3036. Impact track number 3035. Trying to determine if actual ballistic missile was launched since no space track number is associated with the launch or impact point.

Sit was a JPJ DTT (Dynamic Test Track) that was launched was not in timing with the FDP MSELs.

Response from FDP cell was to verify tracks and not call Fireball.

JSTARS is 15 minutes from station, beginning to pass IPB (Intel Prep of the Battlespace) planning information.

0931
Time of last report was 0930

0930
Shortcoming of comm plan is watch officer has no direct link to VTIS (Vessel Traffic Info Service) directly on a net Vs. telephone. He can talk to Coast Guard cutter, a good thing.

0940
Passed to the PR to make sure they send the CAPS overlays on the Compass call in the morning for Avenger stationing.

We're working with the Avengers restationing and communications. Lesson learned: There's a lot of concern about where we can and can't put the Avengers. We should get clearance ahead of time about where to station them.

0950
JPJ as previously planned, exited harbor and conducted turnover of inner harbor defense with PR. PR now headed for anchorage 7. Intentions are to fight this morning from anchorage 7. Earlier, conducted a DCP session to go over the additional DAL locations and PR has requested additional assets to go to cover Sacramento.

0951
Keep out zone for PR for TMD missiles raised to 60,000 ft.

0951
Received from CAST 70% probability TEL site is at lat 39'00" N, lon 118'41" W. Reasons 1. The vehicles. 2. Possible hiding site. 3. I/O chemical supplies.

1000
Track number 0679 is a suspect SAM site, received via TRAP.

1005.25
Multiple Fireball Fireball
Three missiles launched genesis: 38'11" N, lon 121'51" W.
TN 4952/3/4
Area at risk Concord
Sensor ELINT SPY
Time of Impact 1610.07 local
Genesis 39-10 N 118-59

1007
Birds away

1008
San Francisco incorrectly reported as impact point to CMOC. Corrected to Concord.

Redefine Richmond as impact point

1011
We had a good link so we saw the ship tracking. This makes a better elipse of impact. 30-40 seconds faster to JMC than yesterday.

1011
PR TBM track unengageable. Used engageability bypass. System still did not fire.

TN 2007

Impact point was not on the DAL

1014
Sit rep for PR is that the single profile scud impacted near Concord. 33 nm N outside their DAL. They attempted to launch 2 missiles. Both went into engageability bypass. The system would not let them fire. No missiles left the rail. No missiles were fired. This is a realist sit in that one ship can only cover so much territory. Impact area was outside the DAL by 33 nm so the missile was unengageable.

1018
Fireball Fireball call to JMC / CMOC
Low slow flyer 2027

TN 3060
49153
Genesis: 15 miles SW of Fallon
Crater 3759 N

SHORAD Avenger has been told to take responsibility for low slow flyer.

1022
Coast Guard relayed via HF secure comms four unidentified high speed small boat threats. Four high speed boats heading for PR. Tasking Coast Guard. Coast Guard Cutter Long Island relayed info to Slice Boat so that it could activate harbor defense assets.

PR engaged with SM2 block 4 A. The missile engaged at 39 A.

1026
PR reports impact point looks like it is over water.

1026
The third fireball is 31 miles NE of Oakland.

1027
Small boats are declared hostile.

1027
CG has ID'd four boats hostile.

1027
No hostile intent shown by low slow flier.

1027
Low slow flyer is hostile. Unable to engage. Contacting Avenger units for engagement.

1029
Low slow flier. PR is in linebacker mode unable to engage with missiles.
Will try to engage with guns. If unable to engage with guns it will turn over to avenger
Tgt is headed SE over Treasure Island

1031
PR reports unable to engage with guns. They never held the track.
Track headed NW
Lost visual on it.

1032
Track changed direction.

PR holds air track visually, within gun range; but doesn't hold track, so unable to fire.

1031
Try to track craft to airport. Tgt heading out of area to NW
ROS??

1035
Hostile act
no spy radiation in harbor
Preplanning would have helped
takes 8-12 min to go out of lineback mode
surface radar limited
PR's (?) initial contact was visual
Lesson learned:
We put our own blinders on by agreeing to restrictions on not radiating SPY in the harbor and being in linebacker mode.

1037
low slow flyer contact - visual contact - came from the north. It approached ship from the stern, made a radical maneuver to go outbound, then made a dispense. After dispense, ship realized it was a hostile act. With no spy radiation in harbor, a lot of the normal things we would have done preplanned could not happen. PR was in linebacker, so unable to pick up contact with camera or radar.

Low slow flyer was never made a track number on LAWS.

Question: Was there ever a visual location of where the low slow flyer landed or took off from?
Get more about tack memo on linebacker and TTP's for low slow flyer.
Filling in previous record on fireball:

TN 4829/34/4955/4956
Area at risk: East Oakland
Sensor: ELINT
Impe of impact 1022
Genesis: 38'34" N 118'32"
Crater: 37-56 N 121-44W

1043
TN 6112 reported over net. possible low slow flyer
Filling in prev record on fireball:
TN 4952/3/4

Area at risk: concord
Sensor elint spy
time of impact 16 10 07 lacal
genesis 39-10 N 118-59 W
crater 38 11 N 121 15 w

Filling in prev record of fireball:

TN 4959/58
Area at risk E Berkeley
Time of impact 10 27 local
genesis 39-04 N 118-38 W
Crater 37-=54 121-49 W

At 1043 report on command net that "low slow flier track 6112" was observed. Confirmation of call was made. Confirmation by FDP does not hold this track however. No other information available and no action taken by the FDP.

1052
IW indicates that Orange has dispatched a CM-capable truck from a base NE of the city toward the city. Possible launch sites, Richmond and Berkeley. PH, COR, PR, BHR at risk.

1053
All ships bring up slick 32.
Prepare for conventional or directed energy weapon.

1055
Confirmed band steady believe it is commercial radar, hostile J-band emitter, coordinate defense using
Bearing is 000 from PR

MIU 105 (HDU) activated blue forces to provide a layered defense around the high value unit (HVU) COR.
In response to potential high speed boat threat.

1100
Currently tracking both a truck and a boat.

1100
NCS operating from CG vessel traffic service reported two merchant ships passing through the operating area during exercise. The two merchant ships are ID friendly and requiring protection from HDU (Harbor defense unit). The merchant ship info was passed to the HDU for protection and deconfliction of the merchant ships.

1101
Debrief of possible CM attack. Area Defense Commander of PR reported I-band emmitter bearing 004 at 1055. The PR went to general quarters in estimation that CM attack was

underway. Air Defense Coordinator alerted other ships, BHR, PH. They did not , as tasked, put an ESM bearing line in the link and did not coordinate to try to get ESM fix with other ships

The track drifted from 004 to 000 and the scan type never changed from search to acquisition. After approximately three min of tracking PR evaluated the bearing line as non hostile and stood down from CM defense.

Lessons covered between FDP and PR were that PR needs to use the link to give visibility to the tracks not just for the FDP commander but for all ships and will do better at coordinating a defense not just with PR but with other ships in the harbor.

PR is still remaining in the linebacker mode which is risky in that they have no missile defense against either aircraft or CM using SM2. This is according to plan though, because they still need to maintain BM defense for the city.

1116
Low slow flyer TN 2041 reported over command net by PR. 55 radar contact. Lost track. Track picked up by SHORAD and re-recorded as a link track 6062.

1120
The low slow flier has zigzagged. Now 6062 inbound low slow flier. Headed east toward city. Coming toward port appears to head over COR. Maneuvered to port. Now over COR.

1126
MIUW reports two trucks carrying missiles at Richmond wharf. JSTARS requested to take for action.

1129
Low slow flier inbound PR now turned inbound toward PR. Located 3nm north of PR. PR covering with small arms from deck. Avenger covering.

1131
MIUW report wrt truck carrying missiles - sensor is "intel report".

1132
Request made for lat/long on truck carrying missiles to be used on EDGE.

1135
Lookouts on COR identified something. An unidentified RI boat.

1135
PH went into air defense posture.

1139
Harbor defense requested to order PSU to investigate the RIB heading towards CO.

1140
Reference point for the possible warhead carrying trucks is set as 2044.

1143

PRY reports to BHR that there is as possible cruise missile threat. Watchdog requests that the SLQ 32 be turned on by all possible units lnd create LOBs that can be placed into the link system. PRY requests he net to do coordination with BHR as ADC.

1150
Issue raised that the Avenger was never given the signal to take the LSF for fire. This is being deconflicted via landline.(ADC is raiding this as an issue).

1150
B asks for Stalker information to be displayed.

1155
ADC reports that they are unable to reach BHR on AADC&R. Changing to another UHF net(?)

1156
JSTARS has small boat tracks. Passed to CCG cutter Long Island. ADC will pass via ADC&R in event that there are no other possible comms available.

1157
PRY cannot come up with harbor defense commander and will try to pass via bridge to bridge. FDP coordinating through SCC.

1159
JSTARS reports to SCC that a small craft is paralleling shore in vicinity of pier 35. Not established as friend or foe at this time.

1200
ADC reports no communication with the CG cutter via Bridge to Bridge, requests Wartchdog contact CG cutter Long Island.

1205
Request by Watchdog (WD) to have the cutter come up on PRY bridge to bridge comms.

1206
JSTARS reports fast mover one mile south of Alcatraz. Heading towards CO. Reported over command net to PRY until PRY can come with comms to the cutter.

1213
PR has contact, a boat, heading away from PR. Crew wearing military uniforms.

1217
Discussion with FDP commander and ground commander in CMOC (Civil Military Ops Ctr). This morning's low slow flyer attack showed how vulnerable we are over the water for chem dump. PR was in BM mode. Trying to modify defense by extending defender coverage by pushing two or more trucks on Angel Island, we would provide better protection against low slow flier. No JSTSAR assets available.

1219
Small craft approaching N to S approx 1/2 mile N of BHR position, reported to BHR.

1221
confirm three small craft in group.

1221
PRY reprots small boat crossing bow. PH holds a zodiac and JSTARS is reporting as well.

1222
PH reports 6 small attack boats south of Alcatraz.

122
PRY report amplifying info on LSF. Avenger was never pulled off of the LSF track, and was being fed info from JSTARS. Possible disconnect with respect to JSTARS-Avenger. Additional info may be helpful with respect to the C3 issue--for later consideration.

1225
BHR IDs 3 Boston whaler type craft. MIUW is still trying to determine whether players or port traffic. BHR assesses as regular (non-player) traffic.

1230
Late entry. Comms with the cutter established. C3 link through the SCC to Bravo Uniform (MIUW van).

1231
Watch note that most of the contact reports are being made visually. As of this time the SCC holds none of the surface small boat contacts as hostile.

1239
ADC reports possible LSF in vicinity of PR. FDP covers by communications with Avenger.

1242
PRY reports 3 small boats coming out behind Alcatraz and moving towards San Francisco. Requests ROE on LSF.

1245
Pelican video up in FDP cell.

1248
Trying to tell the PR where to go based on the video from Pelican

1252
Having trouble interpreting what we see over Pelican. Can we get someone from Pelican to explain?

1255
Carol recommends stepping outside for a visual.

1255
Coordinating JSTARS, Pelican and PR all together.

1255
Need Pelican picture to display GPS and track number to clarify what we see.

1255
Request to the Pelican to go to the Richmond coast to show those tgts.

1256 Confirm PR also has LAWS up.

1256
Message to medical for him to bring up picture as well.

1257
We were able to correlate Richmond here with Pelican Lat long stamp.

1257
PR unable to copy LAWS images of Pelican video. Software not installed.

1302
Pelican is going to refuel, back at 1500

1303
BHR reports a jetski.

1304
Jetski circling BHR. Has a camera, believed to be civilian. BHR unable to ID as anything other than civilian jetski. Advice is: Check for origin, also challenge them verbally. BHR, direction: came from Alameda. Advice from Roy: Send him away from BHR.

1308
Jetski is outbound toward San Francisco. Camera was video camera.

1308
Jetski did not affect anchor chain that it was circling in any way, constant anchor watch confirms. Jetski toward Pearl Harbor now.

1310
Coast Guard Cutter Long Island to intercept.
Correction, jetski headed toward PR.

1320
PR reports jetski is hostile. FDP cell recommends proportional response. An orange boat is attempting to intercept jetski.

1321
Low slow flyer is in contact with PR via VHF. LSF is not known if hostile by PR. FDP is recommending 5" guns if LSF is hostile. FDP CDR is giving PR approval to engage if deemed hostile. PR is unable to determine intentions of LSF since it could be civilian a/c.

1324
Joint Stars has identified an object approaching the PR on a heading of 010.
MIUWU is reporting possible chemical agent release in water around COR. FDP cell has deemed it as not a threat to ship operations

1339
Pelican has returned to station

1345
After two days of trying to establish Western Area Defense Network, we have been unable to link to the FDP cell.

1349
I&W on truck mounted missiles-trucks will be operating continuous wave at 9GHz. Slick 32 should be looking in that range.

1354
Line of bearing has been produced by a SLQ 32 hit.

1358
Correlation of ESM and LOB to missile alert. CWIS has been placed in alert based on threat at 050. PE Cell has video on truck convoy in vicinity of LOB.

1359
FDP watch CC does not authorize use of 5" guns on convoy due to possible collateral civilian damage.

1359
ESM detected from vicinity of trucks.

1400
Sweeping ESM from dir of truck convoy without lockon.

1401
Simulate activating V3 from PRY

1404
Vectoring small craft assets along 055 from PRY to investigate missile carrying truck.

1406
Fireball track 6001 est time of impact 13; track 2057 is impact point.

1410
PRY intends to engage; could be chemical weapons; est'd to land in water; FDP has granted permission to engage.

1411
PRY indicates second fireball; birds away on track 2055.

1413
splash track 2055

1415
fireball track 2062; PRY reports it is unengageable;
mission cease on 052 true.

1417
track 2062 beyond DAL coverage; assessed as no threat

1420
we would simulate call to CMOC for assist by local PD to recon possible truck mounted Cruise missile in vicinity of point Bravo (watch captain note)

1430
Concerning DEW event; truck assessed by intel to be in a position at which no shot is possible. This is confirmed via STALKER. Experiment can continue if truck is moved to another location in which a shot is possible.

1345
Found two possible CM trucks. 37 52 09 N, 122 17 38 W. They are stuck in traffic on the freeway right now.
Stalker will run some possible destinations.

1550
Comms with PR. Stalker shows Richmond Pier area.

1550 Pelican discovered staging area of two trucks believed to be carrying CMs. Watchdog directed PR to place a reference marker in the link on the two trucks. TN 2076 (Link 16)

Engaged Stalker to place the trucks position, use a 35 mph transportation model and calculates the amount of time to get to optimum launch position.

Moving UAV to follow. Provided CM threat info to ships in harbor.

1555
Stalker found 12-16 minutes traverse time.

1602
Trucks are moving again.

1603
Based on stalker, trucks could be in optimal CM-launching position in 12 min.

1605
FDP cell requested launch of tactical TLAM to loiter points one and two.
They're being launched at this time as per request.

1549
EOD disarmed the Chemical threat that was set to go off at 1600. They separated mustard gas from the explosive devices that they found.

1610
Two trucks monitored by Pelican UAV (position noted). Stalker is being used in case UAV loses track on the trucks and needs to reacquire. FDP commander is relaying target position every three minutes to PR. PR is using that position for the center of the CM threat sector.

All the ships in the harbor are monitoring link 16 and if the trucks start to radiate, they are prepared to engage them with CM defense.

1419
PR? requests a still from the video be relayed over LAWS or another whiteboard.

TN 2204

1422
Previous models showed that we were going to launch the CM only in the Richmond area. The vehicles have crossed over into San Rafael. Asked Stalker to do a new model to see if now on this side of the bridge what the optimum launch positions are. Working with PR to see how accessible the CM launch position might be from that side of the coast.

1426
Speculating on the threats. It could be a ship, a commercial ship, a land target.

1630
Based on latest look at trucks in San Rafael, they may be positioning themselves to shoot at something commercial in the harbor, or shoot at a ship in the turnover in the harbor tomorrow (VIPs on board). Called down to CMOC, they are tracking as we are and passing info to govenor. Recommend we use the CMOC to contact local authorities to see if we could put a shadow, FBI or a SWAT team from the police on the trucks tomorrow.

1630
The SDC (Surface Defense Coordinator) contacted Navy Control Shipping for updates of possible targets of interest for the suspected mobile CM trucks.

1435
Battle Watch Captain just came back from the Precision Engagement cell. They are tracking the trucks. They also have a street map called ALARME??? They want a decision by the commander when they approach the fork in the road. They've established two interdiction points, one if the truck went left, the other if the truck went right. The truck has entered an area that is wooded.

1435
We've regained the tracks. 37 54, 122 28 Looking at a map. They've taken the eastern branch. There are two roads down the We've alerted the CMOC and they've alerted the FBI and the police. They'll go to an interdiction point on the southern peninsula. They'll just monitor, wait until a truck commits a hostile act. If they radiate, we'll take down the trucks before they can launch.

1445
SDC contacted NCSO at vessel traffic service. Based on possible missile threat, all ships inbound and outside 40 miles to stay out.
Correction, NCSO will notify all ships inbound and outside of 40 miles from the Golden Gate bride to stay out.

1653
we have call into Naval control of shipping and Coast Guard VTS; if the trucks want to pick a commercial target, there are 4-5 excellent targets entering and exiting right now. We recommend

to Coast Guard that they close the harbor until we get the intent. CG via normal system for all of the pilots are going to stop all traffic outside and let remainder of traffic pass through and then seal harbor.

1701
Fireball; Oakland area at risk; time to impact 3 minutes; medical informed

1705
Birds away track 2032 PRY missile track 2041; sensor DSP; time of impact 0108Z; genesis 38-47N 118-03W; Crater 37-48N 121-51W; called fire mission over LAWS against the launch point;

1708
PE targeting launch point (simulated DD21)

1710
position of intercept 37-50-28N 121-59-37W

1711
Fireball TN 3570/3576 2045/57; area at risk East Oakland; sensor DSP; time of impact 0118Z; Genesis 38-51N 117-52W; Crater 37-49N 121-54W; LAWS did not receive track; impact point 2044

1715
birds away 2045

1718
Scud missile launcher destroyed

1729 T
rucks still on move continuing procedure to pass lat/long to both Stalker and PRY; giving updates to Stalker in case we lose UAV; passing updates to PRY to give them SA; they have tried to clear traffic in harbor in case trucks did set up.

1800
Trucks have stopped at position 37 55 55/122 24 35 (some type of industrial complex); passing info to CMOC to set up surveillance for this evening; raising PRY in accord w/ pre-sched DCP meeting; passing truck file to them; tomorrow am will pass Stalker material via COMPASS to PRY; PE informed us that they have two helos overhead if we need to engage.

Nighttime events from 16 March
BU taking station in vicinity of anchorage 7.
B 7,8,1 sectors for Long Island 37 49.12 N, 122 22.6 W

2041
EX: Intel. May be attacked Pier 7.
Long Island 1-2 k 000T-270T
BU .5-1 k

2042
Anchorage 7 may be attacked by boats (CRRC) / swimmers
Corr 090 4.5 kts

** threat axis 000-270T
2 PSU's circling PR
300-500
2 PSU's Pier 35

2100
COMEX

2110
Contact near A7-PSU enroute

2120
Sea Land Tracker detected two small unlighted / unID'd small boats. HDU detached CFC Long Island to investigate

2130
HDU reports no contacts

2150
PSU contact

2205
Diver Possibly in water 250 yds N of PR via PSU

2210
PR reports two small boats 25' SBU 250 yds N of PR

2218
PSU recommends dropping concussion gren.

2223
BU RPB 2 sm vessels fr ALCA

2225
PSU --->
BU simulates contacting EOD via contact flt ctrl re: secure of UAV

2230
sm contact HOG SSE; PSU to intercept, pier 35

2232
2 more contacts

2233
Blue contact ID'D by PSU "Popeye" PSU Returns to ALCA

2238
Simulate EOD boarding PR for inspection

2239
PSU ID's poss SBU entering marina

2242
PSU ID's OPFOR SBU and interdicts it

2243
Fast mover from A-B span, by CG Long Isl.

2244
Belay CG, Long Isl's last

2247
2 unID'd vessels by Pier 35

2318
BU NRT to pier 39

17 March

0730
Morning meeting
Talked to SMDBL re getting the Avenger data to the PR over COMPASS and CAPS overlays.
Discussed capabilities of Avenger with all participants (Avenger commander present).
Got a new DAL. Need to make sure PR received it and find out whether they have any stationing recommendations for the Avengers.
Two Patriot batteries should be in theater Friday. Discuss with PR stationing requirements / recommendations.
Evaluate positioning of US MC to ensure Avenger coverage.
Working the WADS data link.
Pass the WMD FTP files over COMPASS.
There are lots more morning meeting minutes on tape.

0845
CAST TEL site 70% probability pos 37.48 N, 122.30 W. Reasons: tracked vehicle possible hide site biochemical supplies.

0852
Fireball fireball. From space threat. TN 2074 from PR, sensor is PR's SPY. We confirm on our display. 1242 is launch track number, we don't have it from linebacker ship.

0855
One minute to impact, East Oakland or E Berkeley

0857
Received IW from CAST, they had info from satellite. COMINT, SIGINT and overhead imagery. Trucks in area, tels in area, cl 74%
IW from DSP first, not seeing linebacker track, operating on less than accurate information

Killed at 78000 ft

More below.

0901
Fireball fireball, second track.

0903
Watch captain Informed Medical that impact point is Antioch.

0904
Birds away against missile threat.

0905
Kill reported against missile at 75K feet.

0926
Notes: About ten minutes after the report from CAST we were able to receive a DSP STRED warning of a launch. Received three separate events. All STRED events displayed launch and impact positions. CMOC was called almost immediately as soon as we received the crater position (vicinity of Oakland) and Antioch in San Francisco. All of the presentations were engaged were engaged by PR with SM-2 block 4A. Unfortunately we did not see the fly out of the missile. That is critical because we are trying to tie in EDGE here and in WMD so that we can provide the intercept position and altitude so we can provide expected lethality to the CMOC. Bottom line is that we need to improve link connectivity or the ability to get tracks from the PR including the DTT of the actual missile and SM-2 fly out, crater and genesis. JPJ has had no luck getting any force-track video. Intent now is to direct them to come out of that mode and go into the DTT launch. They are set up to do a test of that at 0930 to check on the connectivity. Concerns about the link at this point...JPJ and BHR are reporting that they are not getting any comms from the MLV. The ADC is checking with the JICO to see what the problem is.

0938
report the MLV is down due to loss of power.

1100
Prior to sensors lifting off this morning confirmed w/ Sensor Cell that we would have a P3 w/a Pioneer sensor from 1100-1700; Pelican

1000-1400
w/ 45min break for refuel and back on station at 1500; concern that we have no eyes on cruise missile trucks and we have other tasking to monitor and hand off and take down to harbor police of a weapons carrying WMD contraband carrying cargo ship. We've selected a live ship by going through CG and the VTS was due to enter the harbor at 1130. Right now the Pelican controller is BU, MIUW, and harbor defense commander have the info. Once the UAV is over the container ship, by the ROE the FDP cell will make an eyes-on-target confirmation that this is our guy and work w/ Naval Ctrl protection of shipping to get the info to harbor police to intercept the container ship prior to arrival at pier.

Interesting thing w/ link this morning: only way COR is getting Link16 (critical to see launch and impact of an SM2 block 4A missile) is via phone line from MLV. All ships are sending their info to the MLV and it is translated to phone line and we recv via Link 16 phone line. Critical issue is we worked hard to get regular installation of HF LOS LInk 16 system, but unable to get it operating. So we have a single point of failure for FDP CDR to observe scud launches and impacts and engagements which is critical for us to get info to CMOC. Bottom line here is we loaded an LMS 16 but it went to the PE cell. This was an incorrect installation and should have come into the FDP cell. We found out that it is a completely different phone line coming from the MLV and all morning we have not been able to observe Linebacker ops. ID'd that we had another LMS 16 system that had a completely separate phone line from the MLV to here. LMS 16 is an excellent tool that can color code all reporting responsibilities and shows launch and impact and fly-outs. This morning's event in FDP cell we didn't see any of the fly-outs. We put in all of the events on LMS 16, so it has a great recording device. We should have brought in LMS 16 and made part of cell. We will try to work on night of 17th and shift the installation in here so we have redundancy in monitoring BM ops and LINK 16 ops.

Update on WADS: WADS supposed to be est'd at 1000 and the pipe which is different from original set up is to take WADS info at San Diego via FCTCPAC send it up via SAT link 11 to MLV which has capability via USQ125 to recv satellite TADIL A and send it out over broadcast by MLV on Link 11 to all ships which would be an Link 11/LInk 16 mix. Right now we still do not have that connectivity and the problem has been getting the satellite access. We were supposed to have sat access from the beginning. We found out that conflicting req's w/ JSTARS who also req'd Satellite for their systems. This req't ended yesterday and are in the 12th hour w/out satellite access. We should have it by 1200.

1140
5 Minutes ago the level of air activity increased ten fold; the Western Area Defense System link appears to be up. WADS takes FAA civilian tracks and military tracks pumping them up via satellite from SD to the MLV. The MLV rebroadcasts them out to the ships. Confirming right now that has been rec'd.

1255
Passed to JPJ last known location of cruise missile trucks, additionally passed them via stalker model optimum location for cruise missile engagement. Setup a cruise missile defense sector to the north of JPJ. JPJ is prepared to engage using conventional or directed energy weapons. Running Pelican, and we just broke off from the contraband carrying ship, running Pelican to run up the line of bearing to find the trucks.

1218
Inbound merchant vessel NYK Vega initially tracked by NCS Shipping Control Team at VTIS. Tracking info relayed to MIUWU. Unable to enter track data onto JMCIS from MIUWU van to FDP cell. FDP has to manually input the track data. Once we had track data, we tasked BU to collect imagery via P3, until the vessel passed the Golden Gate bridge. Once in the Bay, imagery responsibility was passed to UAV. After thorough imagery collection and capturing stern name, Watchdog was able to simulate releasing of civil authorities to intercept target. MSEL event successfully completed.

1300
Finex MSEL event involving NYK Vega. UAV then tasked to proceed to point Charlie to investigate two ASCM trucks.

1311
Based on ESM hit 349 degrees true from JPJ, Watchdog vectored UAV to point Romeo.

1315
BU tasked to return to base. Watchdog maintains imagery of target area via UAV.

1310
We received an alert from JPJ. JPJ trying to correlate an emitter, but before she could, she lost it. Sending UAV to Richmond coast to try to find source. Based on the fact the emitter ceased, will pass to the UAV that the truck may be on the move. The intent is to try to go from there and to expand the search.

1320
UAV vectored to point Charlie to search for ASCM trucks based on imagery from last three days.

1347
UAV detects ASCM trucks at point Charlie. 38 01 N 122 01 W. ASCM trucks are parked imagery is clear.

1400
Two Uhaul trucks located by Pelican, now using Pelican & P3 with Predator tied together operating as a team under the J2 cell. Location of the trucks 38-01-36 N 122-00-42 W; based on non-movement, waiting on any movement to pass on to JPJ for CM defense; negative activity on Scuds; have sniffers out for ELINT, SIGINT and any other usual indications w/ overhead assets; NYK Vega has been diverted by harbor police to a safe place; continue to monitor link which is probably the most urgent priority in doing the work in establishing a WADS link via land line or satellite; focusing, since we have satellite access; also have low confidence that the MLV is able to forward link 16 tracks which again are life blood for systems like Edge and DAMS and LAWS, etc. that are tied to FDP. w/out Link16 tracks we don't get the BM launch impact or vehicles.

1415
Pelican video ceased according to plan, with P-3 standing by to reacquire. P-3 not situated to observe the vans in their present location. FAA flight plan will not allow the aircraft to be north of their present position. When FAA approval is obtained, P3 will move and reacquire video.

1418
PE cell reports the vans reacquired with video by P3.
Per previous note, tried to see the feed from the P-3, but no joy in the JOC. Is the feed coming in?

1428
Feed from P3 is not available in the FDP cell. It is being fed to PE cell, but last word was that the P3 had to maneuver, and lost track of the trucks. FDP is awaiting word of reacquiring the vehicles.

1450
JPJ report of possible missile emitter in the direction of 350.

1451
Fireball report.

1451
Crater report. Track 3472. Antioch/Concord area is the impact area.

1454
Second fireball report. Impact area north San Francisco.

1456
Third fireball report. Second fireball impact is in the water.

1458
Area of risk is East Oakland.

1500
Third area of risk is San Francisco.

1501
Report of birds away on last group of missiles. 38K feet intercept over San Francisco.

1503
Fireball reports summary: Track 3471/3, sensor SPY/STRED; TOI 2252; genesis 38-59N 118-43 W. Crater 38-03N 122-01W. Track 3502 area of risk East Oakland; acquire by SPY. TOI 2258Z; genesis 38-57N 117-57W with crater at 37-44N 122-38W; missile kill by birds at 38K feet over Hunter's Point. Track number 3502/3501; area at risk is A South, acquired by SPY; genesis 39-07N 188-33W; crater at 37-56N 121-53W

1515
UAV (Pelican) video back up. Trucks are not yet located.

1535
UAV acquired trucks.

1556
Line of bearing established for truck position. Intel reports provided data for LOB.

1600
Sitrep by watch captain. Trucks split up. P3 is taking the north truck and UAV is taking the south bound truck. Concern is that the trucks are moving further south than they were able to move yesterday (Berkeley) and they could be moving as far south as Alameda. Have alerted PH, and attempting to reach BHR. PH reports that the SLQ 32, RAM and DEW are ready to activate. Have alerted JPJ, which is presently shielded by Treasure Island. Will attempt to get a Link track on both tracks and put up two threat areas for CM defense.

1608
Both trucks are heading south. JPJ has reported a hostile emitter that was only active for 30 seconds and the frequency did not match the frequency from yesterdays cruise missile alert. JPJ evaluates non-threat, because what did not correlate was the position of the trucks and the position of the emitter. Have already alerted BHR and PH to have a cruise missile defense set up.

1615
The two trucks have a mile and a half separation. Continuing to proceed south. Latest position 37 50 42N 122 17 57 W. JPJ continues to report about 13.6 GHz which is higher than J, which is beyond what the cruise missile emitter is. The emitter is NE of her in the Berkeley area. This is

evaluated as non-threat based on the fact we have VIB coverage of both vehicles. Both trucks are working through traffic and are considered non-threat.

1715
Watch captain sitrep. Watch captain was in J2 cell and observed that both of the trucks had joined up (they had separated and UAV on one with the P3 on the other). They were observed moving into a parking lot and backing into parking spots, where they swung their back gates up. In this position they were placing weapons facing out over water in the direction of ships. This was viewed as possible hostile intent. All three ships PH, BHR and JPJ were alerted. Immediately following this a steady CM emission was picked up by CO, PH, JPJ and BHR (SLQ 32). For CM defense both JPJ and BHR activated DEW, with JPJ using CWI emitter with 5 sec on and 5 sec off, repeated. JPJ CO concerned with keeping the CWI going over Treasure Island and ceased after 3 bursts. BHR and PH continued (simulated) and tried to put camera on the target. PH reported emitter cease. This is an indication that the DEW was effective. Permission was obtained from C3F for use of 5 inch guns based on urgency. Attempts were made to get rounds on top of the truck via CMOC, vice call for fire directly from ships. Yesterday were able to get gunship helos to track trucks. Once all units reported that emissions had ceased, assumed that the trucks had been hit or that the DEW or SLQ 32 had defeated the missile. We did not command any SBROC firing because of testing which showed that chaff would impact the performance of DEW. Camera recording from both BHR and JPJ (PH does not have capability). PH CO reports that they have a GPS track with the MK 34 GFCS. No confirmation as to what type of ammunition was selected. At this time we are staying on the area of the trucks (UAV). In a real world scenario, we would be able to report a call for fire from the ships, to lock them on the target.

18 March

They also use the experiment for training, could train more.
0730
meeting
Plan response to IW faster today to do a pre-emptive strike.
UAV hasn't had sim UAV, so the exercise hasn't used it as much as it might have.
ADSI hardware doesn't support sw upgrade.

Lessons learned as per conversations last night:
1. Many tools present. It has been a big advantage to overlay them, share information.
2. Command relationships: JAOC was to be only TBMD, not FDP. ECOC would have been a better place to sit. Should PE have been part of FDP?
3. DEW event: everyone wanted to have eyes on the target. Must get optical feed on new weapons.

0843
Following the intensity of the orange SCUD attacks on the 17th, FDP went to the JTF commander pm 17 mar and requested a pre-emptive strike against orange scud forward operating bases. Tasking was conducted using LAWS. Predictive analysis methods were used to select two orbit locations for tactical TLAM at 0730 both JPJ and PR were alerted and tasked via both voice and LAWS. PE cell was advised and PE cell helped coordinate execution. Issue here again, does PE work for FDP commander? or is PE on a level plane with FDP? Recommend that by using the technology developed by the FDP cell (LAWS and LAWS connectivity) that the FDP cell be authorized to conduct their own engagements without PE interference. All that

should be required is that they know about the upcoming attack to prepare deconfliction. JPJ and PR were placed in a ready 30 using Aviation Concepts' TLAM. Ships bring up their system and are tasked to put all missiles into mode 7 (ready for launch). Launch is scheduled for 0830 with a 25 minute time of flight in order to have missiles in place when the IW is received from CAST. Once IW is received tactical TLAMS are vectored into the area that CAST recommends. Again, this type of targeting is meant to be interdictive in nature. TLAM were tracked with spy after launch and broadcast over link to provide required deconfliction in SA for air defense units so our own friendly CMs were not mistaken as FLA.

0913
comms with PR not available. PR moving out of position. Using JPJ to relay messages to PR. FDP commander unhappy with the situation. PR has had equipment problems and therefore are not going to participate. FDP doesn't think it was his decision. PR has been trying to contact watchdog for 3 hours. PR can communicate over DSA.

0919
IW show two launches. Tactical TLAMs vectored to area.

0920
BHR asks about low slow flyers on screen. None detected.
Correction, BHR should be JPJ

0921
Fireball. SCUD launch.
Correction 0919 should be IW of two potential launches.

0922
EDGE predicts impact in E Oakland, impact in 3 min.

0923
TN 3571
Correction 0922 was JMCISS, not EDGE

0924
Ordered launch of SM4 against SCUD if available.
TN 3601

0927
Fireball TN 3611

0928
Fireball TN unknown

0930
Don't see link tracks
Full worksheet.
TN 3601
Time of impact 17232
Genesis 38 47, 117 56
Crater 38 14, 114 59 (3602)

Worksheet
TN 3511
Sensor SPY
Time of impact 17552
Genesis 30 57, 117 57
Crater 38 16, 116 45

Worksheet
Area at Risk: Oakland
Sensor STREO
Time of impact 17232
Genesis 38 48, 117 57
Crater 37 53,121 45.9

0935
Medical unavailable at either JMC or CMOC
Watch commander SITREP: The continuous harassing of the SCUDS and the intensity of the level of the activity of the 17th went to the JTF commander on the pm of the 17th received approval to conduct a preemptive strike on orange SCUD base. This is a change of the flow of the battle; rather than going defensive every day because of the SCUDS, we go offensive. USED the CAST system that's been providing us IW to set up early warning launch of two TLAMS from the PR and two TLAMS from the JPJ to TLAM orbit points one and two, close to Fallon. Sent tracks via link and sent the TLAMS out to the area so that prior to the normal morning launch, the tactical TLAMS ... so that when the I&W was received, we gave the lat long from CAST to strike. Approx 3 min after the strike command the first fireball was hit. These were missiles that were used not for precision but for interdiction.

Decision by FDP CDR: Since PRY LInebacker is unable to launch SM2 block 4A this morning, believe there is a capability per PEO to shoot the SM2 block 4 only at scud and implement decision to have JPJ to come up in NTDC mode and engage the scuds w/SM2 bl4.

Based on C4I configuration, we are set up to receive ballistic missile indications in both TRAP and S-TRED so should be rec'd in EDGE and JMCIS. Also, with JPJ launching the DTTs we should be seeing them as link tracks. The JPJ is passing the tracks, however we are not seeing the link tracks. Looking at that right now.

Situation: we are getting WADS data coming across JMCIS via TADIL B. Maybe we have the TADIL B landline working.

Info from JNTF next time we should go to JNTF for correlation.

1st MSEL event: WADS is up; conducting patterning ops Thur 18Mar

Linebacker has casualties to tape drives which prevents her from shifting from one load to another. We have a program configuration that is a lot harder to shift SM2 Linebacker mode and normal tactical ops. We are trying to task JPJ (since Linebacker is not an option) to develop DTTs for scud launchers and SM2 Bl4. There is an SM2 Bl4 scud capability and it is less than that because there is no IR seeker for the SM2 Bl4, only the normal RF and Blast Frag warhead. LCDR Hux just coordinated again successfully a TLAM engagement using LAWS making a strike in the Fallon area that the scuds have been operating out of. The tactic used was to mix 2 C's and 2 D1's to get both interdiction using the D1's and effects on C.

1105
Sit Rep. When initially tasked to conduct and engagement of a SCUD, ADC / PR reported that she was not in the linebacker mode and could not engage. This was a surprise to the FDP commander in that PR had a casualty to her tape drives and had not reported this to the FDP commander. JPJ was up the NTDC / BM mode and was tracking the SCUD so the FDP commander tasked JPJ to engage the SCUD with an SM2 blk IV. JPJ initially questioned the order because SM2 blk IV is advertised as not having any TBM capability. Lab tests have shown however that there is some capability, so FDP commander told JPJ to use engageabilty bypass and engage. JPJ was able to fire dual salvo yet when you use engageability bypass, your Pk is very low (.35). Lesson is to ensure all AEGIS platforms are configured for flexible defense with redundancy in fires.

Continue to have problems onboard COR receiving link information. All week reception of BM track data from AEGIS platforms, specifically J3.0 and J3.6 tracks have only been observed about 30% of the time. FDP commander uses these essential messages to make warnings, evaluate engagements, and execute defense. One of the key lessons from the FDP commander's perspective is that if a command tactical picture can be developed in all dimensions, this link must be interfaced with new predictive tools such as EDGE and HPAC and additionally interfaced with precision engagement tools like LAWS. This allows the commander to conduct, no shit, FULL DIMENSION PROTECTION. FDP commander fear, earlier in the week, was that we had organized C2 and command relationships to support FDP, but the C4I was not organized to allow him to execute a defense in all dimensions. As additional tools were made interoperable, for example ADSI and EDGE, and ADSI and LAWS, the commander had more confidence in transitioning from defense to offense. (Reliability is important. Know the interoperability, and get operators that have the SA to make it work.)

In the area of surface defense, our initial problem was that we did not set up a formal command relationship between the FDP cell and the MIUWU commander. In the real world, a commander must pull in all sensors and weapons systems under a common defensive and offensive umbrella. By developing a FDP cell that included watch stations and representatives from every medium of defense (space, air surface, subsurface), the commander consolidates both sensors and weapons and by doing so, not only achieves conservation of assets, he additionally improves his span of control and his execution. Initially, FDP commander was not tasking the surface watch properly because the asymmetric pillar / asymmetric dominance working group and they FDP working group did not work closely enough together to work out the command relationships in advance. Even up until game day (15-Mar), C3F was still working with commphibron5 (CPR-5) regarding their role and their command relationship with the FDP cell. According to some areas of the Ex plan, the OTC for the FBE was CPR-5. This did not make sense to the FDP cell, since C3F, as CJTF and responsible for all assets, should have been identified as the OTC. In order to repair this situation, the compromise was that C3F would be the FDP CDR and run the exercise simulation and CPR-5, as the OTC, would have TAC on all ships and execute real-world movements. This approach was doomed to fail and was not accepted because the experiment needs to be able to use live assets, task and direct live assets, and have freedom of movement and authority to control all assets. FDP commander did negotiate with CPR-5 use of ATF command net to direct all assets (live and sim). All units were directed to be up on all FDP circuits and execute guidance of C3F. The only thing left unsaid here was that C3F, although senior to CPR-5, was on a separate phone line requesting to move assets from CPR-5. This was screwed up. And we fixed that by taking the approach that if C3F issued the FDP plan under C3F pen, then the FDP plan was actually an order from C3F to all assets to comply with guidance and direction from FDP cell. **End of log**

G SPAWAR FBE ECHO DRAFT REPORT

General

SPAWAR Systems Center, San Diego (SSC-SD) continued in their support of the Maritime Battle Center (MBC) during Fleet Battle Experiment-Echo (FBE-E), with regard to network data collection and analysis. This brief report provides details on the results of the network collection and analysis effort. The information herein is provided in the form of a white paper or engineering position paper rather than a formal report, thus facilitating its incorporation within the official MBC FBE-E report.

Network data collection was performed in support of FBE-E Phases I and II; phase I was conducted from 10-18 March and phase II was conducted from 10-16 April. SSC-SD provided two network engineers on USS CORONADO (AGF 11) during each phase, allowing coverage of events within multiple spaces in addition to concurrent data collection and analysis during exercise conduct.

Instrumented sites included the USS CORONADO (AGF 11) during phases I and II and the Modeling & Simulation Operations Support Cell (MOSC) at SSC-SD during phase I. Most of the discussion herein will address findings associated with AGF 11, however, where MOSC instrumentation supported findings of interest, they will be elaborated upon, accordingly.

The objectives of the network data collection and analysis effort included:

- Evaluation of USS CORONADO (AGF 11) Local Area Network (LAN) and Wide Area Network (WAN) architecture
- Assessment of on/off ship/site bandwidth usage
- Characterization of traffic content by protocol
- Identification of traffic as generated by experimental and normal shipboard systems.

Network Architecture

The paragraphs that follow describe the network architecture as observed during FBE-E. This architecture will focus on those locations as instrumented with network data collection tools during the course of the experiment. These included AGF 11 and the SSC-SD MOSC. The MOSC facility possessed a relatively simple network architecture. Thus the focus of these paragraphs will be on AGF 11 LAN and WAN connectivity.

The network architecture aboard AGF 11 consisted of a LAN backbone, with several routers, hubs, and switches attached, enabling various connecting media. As of FBE-E, AGF 11 had yet to receive its IT-21 installation, which on other platforms provides high bandwidth ATM switches, enabling high volume network segments against an OC-12 backbone (up to 622 Mbps). Ships previously reported as having IT-21 installations (during FBE-D) included the USS BLUE RIDGE (LCC 20), USS KITTY HAWK (CV 63), and USS BELLEAU WOOD (LHA 3).

AGF 11's backbone is generally not segmented, which is to say that most LAN and WAN traffic from the various attached subnets traverse the 100 Mbps fiber media at any given time. While this arrangement is less than optimal, in terms of network efficiency, it has provided flexible support to the various FBEs and other experimental system evaluations conducted on AGF 11. Moreover, within the context of FBE-E, the AGF 11 architecture provided an excellent opportunity to evaluate WAN traffic across shared LAN media, thus characterizing the impact of the various LAN data on inter-site traffic.

During phase I of FBE-E, network data were also collected at the Modeling & Simulation Operations Support Cell (MOSC) located at SSC-SD. The configuration at the MOSC is relatively straightforward, with several workstations connected on a common LAN, which is connected to a router handling Secret Internet Protocol Router Network (SIPRNET) traffic. The MOSC accommodates up to 512Kbps of SIPRNET traffic. Another key facet of the MOSC's architecture is its support for Multicast routing (selected broadcast) over SIPRNET. The MOSC, through its Multicast router (mroute) workstation, provides routing services for most Dynamic Collaborative Planning (DCP) participants, employing SIPRNET and the Common Operational Modeling, Planning and Simulation Strategy (COMPASS) tools, embedded within a variety of UNIX-based planner stations. More information regarding this subject is provided in Appendix A of this report.

Network Topology

Understanding of the network topology for any such data collection and analysis effort is crucial to its success. Without such an understanding, it is nearly impossible to properly characterize the origin and general content of the traffic collected, much less any tactical/operational ramifications implied.

The preferred means of obtaining network topology information is to participate in the early planning for a given FBE. In this manner, the network data collection and analysis engineers can begin to derive logical system relationships and perform the necessary queries to obtain specifics regarding network segmentation, routing, subnet identification, and subsystem/network relationships. Unfortunately, participation in the early phases of FBE-E planning was not realized by the network data collection team. Therefore, an alternate means of establishing the network topology was required.

For FBE-E, network management tools available onboard AGF 11 provided a unique opportunity to establish the topology "on the fly". The tool was the "UniCenter" network manager by Computer Associates. This tool used Simple Network Management Protocols (SNMP) to establish the location of workstations, servers, and routers across the AGF 11 LAN. Given this information, network data collection personnel were able to provide an accurate representation of those portions of the network instrumented for the FBE. The use of the UniCenter tool, along with the generic application of network management tools and policies, is discussed in greater detail in appendix C.

A high-level view of the FBE-E topology, from the standpoint of the data collection effort, is depicted in figure 1, illustrating WAN connectivity between AGF 11 and the MOSC. Figure 2 focuses strictly on the AGF 11 portion of this effort. Both figures 1 and 2 illustrate the network analyzer data collection tap points associated with the collected data in green. More details regarding network analyzer placement are provided in a later paragraph.

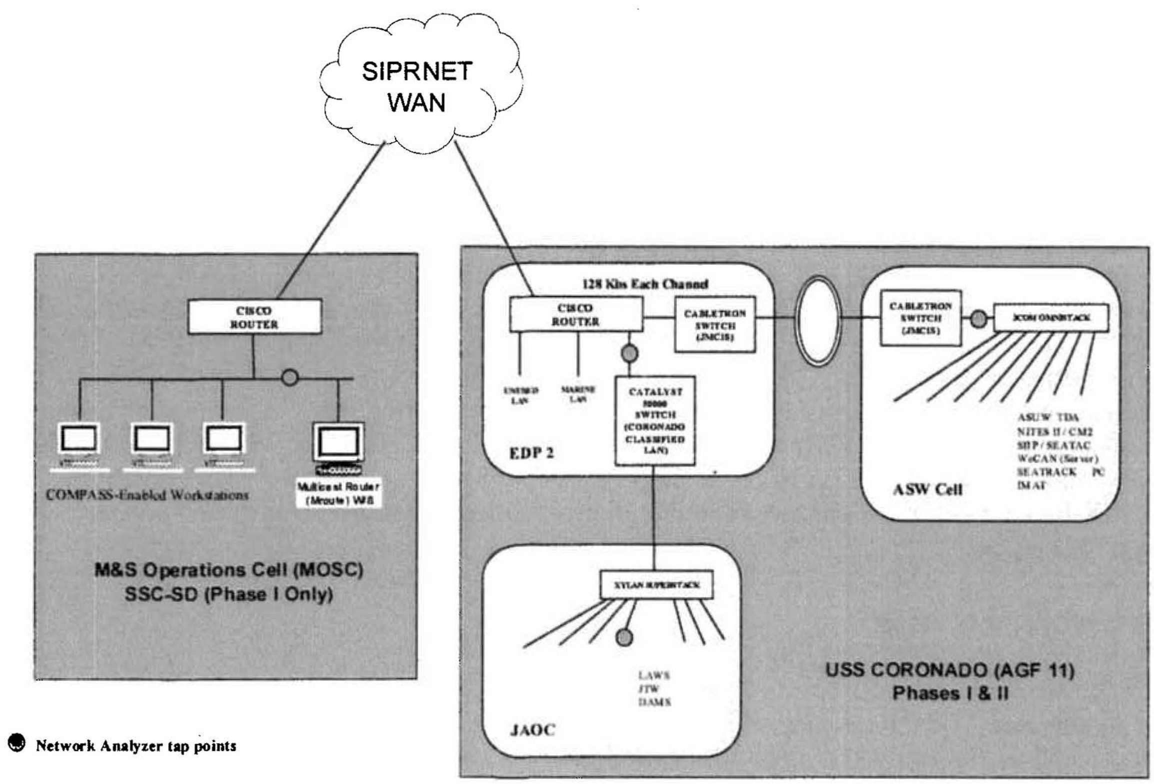

Figure 1. FBE-E Topology Supporting Network Data Collection

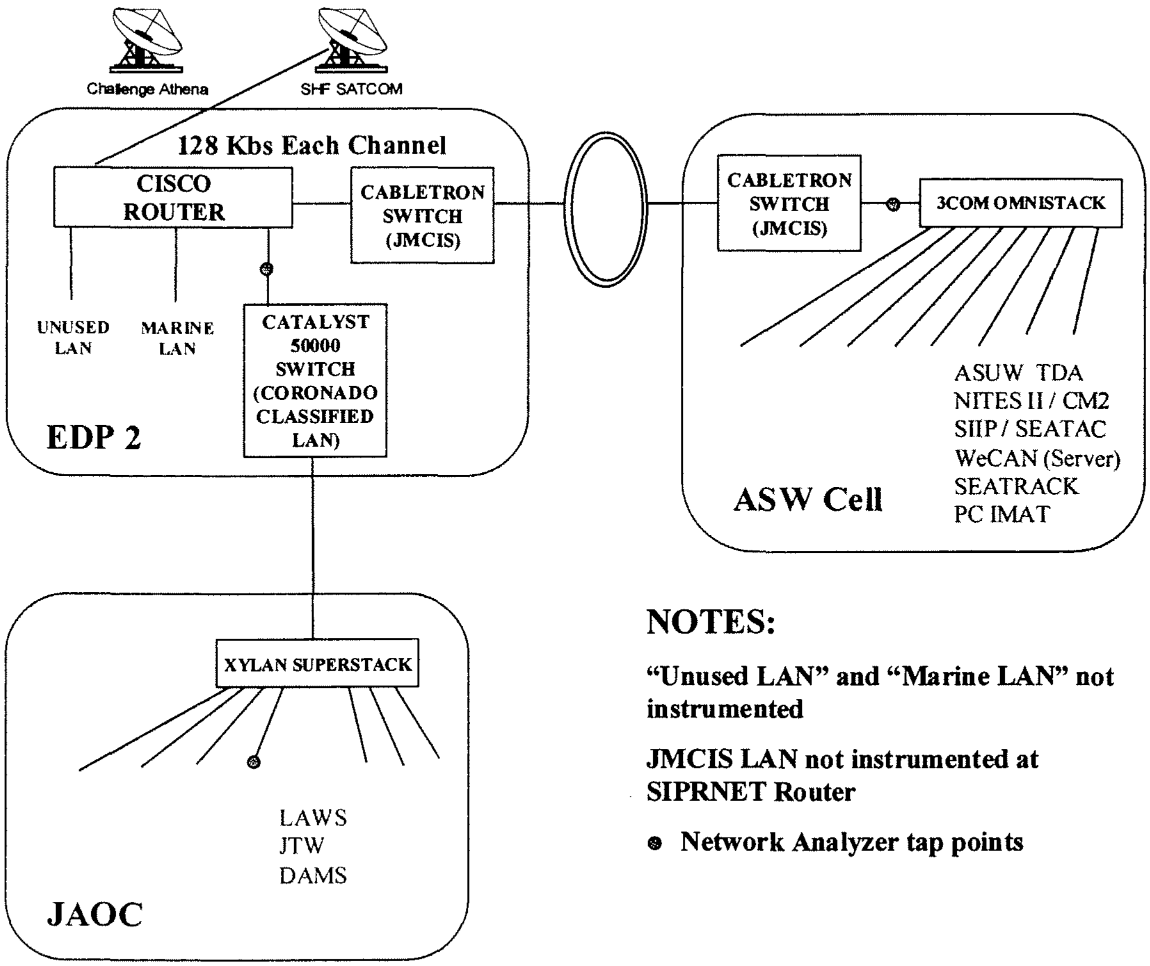

Figure 2. AGF 11 FBE-E High-Level Network Diagram

AGF 11 Exterior Communications

The paragraphs that follow provide a brief description of those components comprising AGF 11 external network connectivity (WAN connectivity) instrumented for this FBE. These exterior connections are illustrated in Figure 3 (along with details of router connectivity) and include the Secret Internet Router Protocol Network (SIPRNET), Portable Surface Terminal (PST), and Wireless LAN subsystems (WaveLAN & VRC-99).

The SIPPRNET connection formed the primary focus of this collection effort. SIPRNET connectivity was obtained via a CISCO 4000 router, which had 4 Ethernet LAN ports and 2 WAN ports. One of the WAN ports was connected to the ship's SHF SATCOM system. This provided 128Kbps of SIPRNET connectivity. One important facet of this connection is that

SIPRNET on AGF 11 does not currently employ its Challenge Athena connectivity, but rather is handled by a 128Kbps SHF WAN segment.

The PST actually consisted of a point-to-point interface between AGF 11 and another station. This system did not actually attach to the ship's network, but rather included its own dedicated equipment. Therefore, this connection was not considered during the course this data collection effort.

The VRC-99 provided an off-ship "wireless LAN" capability and was evaluated as part of the Extended Littoral Battlespace (ELB) effort. The VRC-99 connected to AGF 11's LAN via one of the ELB routers attached to the Unclassified LAN as encrypted or "black" packets. These packets were then converted to unencrypted or "red" data via a Network Encryption System (NES) and forwarded to the AGF 11 Classified LAN as appropriate. This external connectivity had the potential for the observation of a higher bandwidth off-ship connection. Unfortunately, such data collection largely went unrealized, due to the late availability of planning information to the network collection and analysis engineers.

Functionally, the WaveLAN was similar to the VRC-99, in that it was being evaluated as a means for wireless external connectivity by the ELB project. The WaveLAN was essentially a Commercial Off-the-Shelf (COTS) variation on the VRC-99, with a number of performance specification differences. Since data from these "wireless LAN" technologies was not collected, detailed descriptions of their application and performance are deferred.

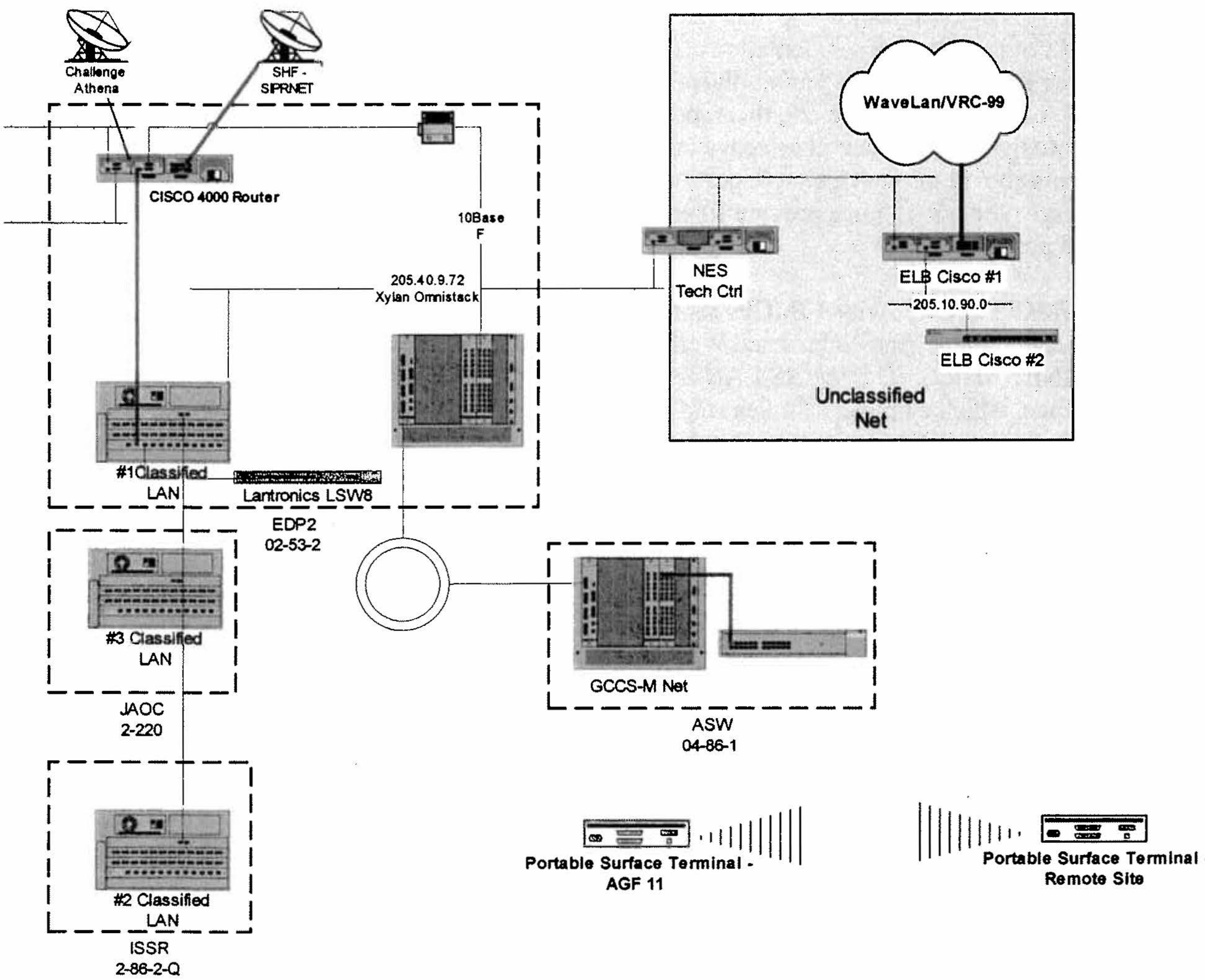

Figure 3. AGF 11 FBE-E External to Internal Interface Relationships

AGF 11 Interior Communications

AGF 11 interior communications of interest included the Classified LAN, Unclassified LAN, and JMCIS LAN. These networks are illustrated in Figures 2 and 3 above.

The distinction the Classified and Unclassified LANs aboard AGF 11 is implied by their name. Information passing from Classified to Unclassified and back, is encrypted / decrypted through the use of the Motorola Network Encryption System (NES). These LANs essentially form the AGF 11 backbone and are comprised of 100BaseFx fiber media, installed by CORONADO personnel. Much of this network system will be replaced / superceded by the pending AGF 11 Information Technology for the 21st Century (IT-21) installation.

The Unclassified LAN provided the means (via CISCO router) to integrate the VRC-99 and WaveLAN during this experiment. Data transferred between AGF 11 and other sites via the VRC-99 or WaveLAN were encrypted /decrypted via the NES.

The AGF 11 backbone LAN (Classified / Unclassified LANs) essentially handles most traffic destined for off-ship data transfer. Moreover, it also handles the majority of internal shipboard traffic. As a consequence, the majority AGF 11 traffic traverses the backbone, without the benefit of the network segmentation afforded via the use of switches. Much of the data makes its way on the backbone via "unintelligent" hubs, where no filtering or segmentation is offered. While not inherently efficient, this topology *does* carry with it the benefit of flexibility. Essentially an experimental system can be carried aboard and physically connected to most other systems aboard through a simple port on a hub. Note: this does not apply in cases where "smart" hubs are used. Such hubs provide filtering capabilities, with regard to connected addresses on a given port.

The JMCIS LAN provided JMCIS connectivity throughout AGF 11 and was the primary means of connecting the Anti-Submarine Warfare (ASW) space to the backbone and other sites (via the SIPRNET router). The JMCIS LAN is comprised of a Fiber Data Distributed Interface (FDDI) interface, which employs a "token ring" topology. This network connects to the 100BaseFx backbone network via a Xylan "Omnistack" hub.

Network Instrumentation

During FBE-E, the network data collection effort continued to employ the Network Associates "NetXray", network analyzer tool. The NetXray is a commercial product, developed by Network Associates, which is MS Windows 95/98 compatible and is hosted in notebook PCs in support of the FBE network data collection / analysis effort.

The network analyzers are configured with 10/100 base Network Interface Cards (NICs), allowing them to be attached to any 10 or 100 Mbps Ethernet port or Hub. The network analyzers employed (using the aforementioned software) are configured to be entirely passive. Moreover, these analyzers are not even assigned IP addresses, relegating them to a receive-only state. The network analyzers are capable of collecting all data available on the attached port. Thus traffic filtered by "smart" hubs, routers, or switches, is not visible to the network analyzer.

Network Monitor Points

Phase 1

During the period leading up to phase I of FBE-E, selection of network data collection monitor point was complicated by two factors:

(1) The network data collection/analysis team had not been integrated early into the planning phase
(2) Due to recent (and quite valid) network security concerns by AGF 11 and the 3rd Fleet staff, the network analyzer notebooks had to undergo an approval process which largely precluded an early ship-check or approval of the TEMPMOD.

Given these factors, network monitor taps were selected with limited knowledge of the capabilities of the identified ports. The AGF 11 network monitor points selected for phase I included:

- 04-86-1-Q: ASW Planning Cell. Access to the LAN was obtained at port 11 of the 3Com Super Stack hub

- 02-53-2-Q: Electronic Data Processing (EDP)-2. Access to SIPRNET was gained through connection to port 4 of a hub mounted on a Cat 5000 router in the space.
- 02-80-0-Q: Joint Air Operations Center (JAOC) Intelligence Annex. Access to the WAN was gained via port 16 of an OMNISTACK hub.
- 2-104-1A-C: Joint Strike Center. Access to the LAN was gained via Port 16 of an OMNISTACK hub.

These monitor points appeared to provide good coverage of both the internal and external networks. Unfortunately, this later proved not to be the case, as the selected ports were contained within "smart" hubs. Smart hubs filter out nearly all addressed traffic not specifically destined for the selected port. As a consequence, only broadcast traffic, not associated with WAN connectivity, was available to the network analyzers on AGF 11 during phase I. More information regarding the issues with such connections is provided under the "omissions and issues" paragraph of this report.

The SSC-SD MOSC tap location was on the MOSC LAN, which provided a good view of external DCP traffic. These observations and their corresponding conclusions are further elaborated in later sections of this report, as appropriate.

Phase 2

During phase 2 of FBE-E, selection of monitor points was modified, based on data already collected for phase I and a refined understanding of AGF 11 hub and router capabilities. The following monitor points were employed on AGF 11:

- SIPRNET port - The monitor point was selected for the direct access to one SIPRNET port from the Shipboard router to the Timeplex port.
- JMCIS port (ASW Cell) - This monitor port was chosen for the access to the 205.40.5.0 network, and the JMCIS data.
- Joint Air Operations Center (JAOC) - This monitor port was selected for its access to Land-Attach Warfare System (LAWS) data.

No monitor was set up at the MOSC during phase II. The captured data was already more than sufficient to fully characterize the nature of DCP communication, from the standpoint of the MOSC multicast route (mroute) server.

Another location that was not monitored was that of the unclassified net containing the ELB CISCO router(s), which provided access to the WaveLAN and VRC-99. In retrospect, this would have proved quite useful however, due to the limited information available to network data collection/analysis personnel prior to FBE-E, a network analyzer could not be properly prepared to tap this media. Collection of such network data (from experimental non-SIPRNET sources) is highly recommended for the next experiment. Similarly, the dedicated PST connection was not tapped. This would have also proved valuable and should be considered a target tap for future collection and analysis efforts, if reintroduced to the FBE environment.

Omissions and Issues

Phase I

During the course of phase I, little was known regarding the use of "smart" hubs on AGF 11. Smart hubs are designed to only forward traffic on a port in cases where addresses of interest are attached (e.g., an addressed IP address). In cases where an unaddressed "node" (e.g., network analyzer) or an address that is not intended for receipt of the message is attached to one or more ports, the data are not forwarded to the attached components. Consequently, only unaddressed or broadcast traffic is actually forwarded to such ports on a smart hub. Since the thrust of this effort (both phases) was to observe traffic through the on/off ship bottleneck, observation of broadcast traffic was of little interest or value. Unfortunately, all AGF 11 network analyzer connections during phase I were attached to smart hub ports. Thus, most relevant AGF 11 observations herein were obtained during phase II. Confusion regarding the use of smart hubs largely stemmed from the belated entry of the network data collection and analysis team into the FBE-E planning process.

Procedural issues, with regard to the classification of collected network data should probably be reviewed as a consequence of this FBE. Due in large part to the lateness of data handling agreements between AGF 11 / 3rd Fleet staff and the MBC, confusion abounded with regard to the procedures for checking in network analyzer PCs and for ensuring collected data disks could be legally removed. This proved to be less a problem during phase II, however, such procedures should be reviewed and agreements made much further in advance for follow-on experiments.

Phase II

As previously noted, phase II possessed a number of dedicated external experiment interfaces. These included the Portable Surface Terminal (PST) and WaveLAN / VRC-99 wireless WAN systems. The PST was actually a dedicated point-to-point interface. Effectively, the same was true for the WaveLAN and VRC-99, although some of their data may have been available on the AGF 11 classified LAN. While these dedicated interfaces appeared to be adequate for their respective experimental loads, they would have required measurement to evaluate their potential contribution to shared media for a typical shipboard WAN environment. As previously stated, the application of these external interfaces within the context of FBE-E was not entirely understood. Thus the significance of such early FBE participation on the part of the network data collection and analysis effort cannot be overstated.

Another area that remains under investigation is the impact of the large network load on the SIPRNET router tap, which was a by-product of the previously described "flat" network design on AGF 11. The network analyzers were set up to collect 4MB files. Due to the ambient traffic load on the Classified LAN (ostensibly the backbone), the 4MB files filled up quite rapidly during the collection process. Oftentimes, these files contained virtually no data destined for or received from off-ship nodes. When attempting to apply filters during data analysis, the resulting files caused errors in the analysis program that rendered the data unusable. Moreover, when attempting to reduce the 4MB files individually (rather than through concatenation, as typical for this type of multi-file reduction), many of the files were found to be entirely filtered (containing no relevant data). Given this onslaught of data, it is quite likely that the network analyzers were inundated to the point where significant portions of the traffic were not collected. Assuming this did not occur, tapping such an active network segment (in this case, the classified LAN backbone), is certainly inefficient. Therefore, one can conclude that either future such taps must be applied to more dedicated network segments (e.g., the serial connection on the other side of the SIPRNET CISCO router).

Network Subsystems and Applications Observed

A variety of subsystems were employed during the course of FBE, each with their own unique contribution to the overall network load. For phase I, while numerous subsystems were introduced, two appeared to make the most notable contributions to the analysis rendered herein. These included the COMPASS and a simulation of a series of DD-21 workstations. During phase II, the most notable system contribution was that of the Web-Centric ASW Network (WeCAN), with its use of World Wide Web (WWW) Hypertext Transfer Protocol (HTTP) to transfer chat and graphics files. A brief description of the use of each of these subsystems and supporting applications is contained in the paragraphs that follow.

COMPASS

DCP sessions were typically planned and executed 1-2 times daily (with occasional impromptu sessions in between). These sessions employed portions of the COMPASS tool set within various UNIX-based planner stations. These stations included the Air Force Mission Support System (AFMSS), the Tactical Aircraft/ Automated Mission Planning System (TAMPS), and Ballistic Missile Defense Organization, Commander's Analytic and Planning Simulation (BMDO CAPS). Most of the COMPASS traffic generated for these sessions required a subnet level broadcast over the WAN using the multicast protocol. Multicast is used to broadcast unaddressed data (e.g., video and audio streaming applications, which are sensitive to time delays encountered with acknowledged protocols such as TCP/IP) to a designated subnet mask, applicable to the group. Specific applications employed within the COMPASS service set were the chat, whiteboard, digital voice, and screen capture overlay sharing. Each of these services employ the User Datagram Protocol (UDP), for the broadcast of unacknowledged packets, coupled with multicast, thus ensuring data packet transfer to a specific multicast group. All COMPASS DCP data were transferred over SIPRNET, which does not inherently handle broadcast or multicast information. Therefore, a series of connections, known as IP tunnels, were established between a multicast router (mroute) workstation at the MOSC and all participating platforms. The use of these protocols and their ramifications are described in detail in Appendix D of this report. At this point it is noteworthy to mention that the network data collection effort for phase I of the FBE largely focused on the use of these protocols in support of DCP.

DD-21 Simulation

The DD-21 Simulation was observed during the first phase of the FBE. Essentially, an attempt was made to simulate the various activities anticipated for a DD-21 system during various operations. While a description of the DD-21 system is beyond the scope of this report, its general purpose is to provide shipboard connectivity services with various supporting shore sites, thus allowing for reductions in shipboard manning and services not otherwise available to forward deployed units. The DD-21 simulation employed within phase I used a set of Protocol Data Units (PDUs) to provide traffic similar to that as projected for actual system use.

WeCAN

WeCAN provided a set of tools in support of the ASW Cell and other ASW units, where participants could collaborate via WWW tools using HTTP protocols. These included chat sessions, file transfers, and graphic transfers. This tool proved to be quite efficient, in that it employed chat, rather than voice tools. For the ASW problem, the chat capability appeared to support the relatively slow tempo of ops and was received with great enthusiasm by all participants. These tools were used atop the JMCIS workstations in the ASW cell, with all resulting on/off ship traffic being forwarded via the JMCIS FDDI LAN to the SIPRNET router and vice versa.

JMCIS

JMCIS maintained its typical set of intelligence links (e.g., OTCIXS, TADIXS, TRE, etc.) and employed the LAN to transport that data between workstations. Within the context of this effort, however, the most significant contribution observed from JMCIS was its hosting of the WeCAN tools, which resulted in the on/off ship traffic described above.

COTS Tools and Services

Much of the traffic collected during this effort was attributed to the widespread use of Commercial Off-the-Shelf tools and services such as Microsoft® NetMeeting, Microsoft® Outlook, Microsoft® Exchange, Microsoft® Internet Explorer, and various other commercial products. Much of this information consists of chat, email, and Web Browsing, which have become a primary means of moving information both intra and inter-ship.

Network Observations

In her capacity as a Sea-Based Battle Lab, AGF 11 possessed one of the more extensive early network configurations. The CORONADO has extensive off-ship bandwidth in the form of Challenge Athena as well as additional capability via a separate SHF connection. During the course of this effort, only those systems employing the SHF system for on-off ship connectivity were observed. As AGF 11's LAN connectivity developed, it did so without the benefit of those network components that have become standard within IT-21 installations. For example, AGF 11 does not possess the OC-12 capacity (622Mbps) Asynchronous Transfer Mode (ATM) backbone found on other IT-21 ships. More significantly, it is not segmented via switches, resulting in a "flat" network topology, where virtually all nodes (servers, workstations, and routers) function as if they're attached to the same Ethernet bus. Thus, all nodes attached to the AGF 11 backbone are required to sift through all traffic on the LAN, without the benefit of segmentation.

AGF 11's network has evolved in this manner somewhat intentionally, in that such open connectivity between systems afforded a level of flexibility required in light of the dynamic nature of its experimental systems. Moreover, this flat connectivity has also been a by-product of the incredible changes in the systems and their respective configurations. Thus a great deal of credit is due those who have maintained this network, in that any network failures would have a tendency to effect many systems, rather than a few on a single segment.

AGF 11 is now preparing to receive her IT-21 installation. Therefore, while IT personnel aboard certainly recognize the need to improve the network architecture, any significant changes have been deferred, pending receipt of the new IT-21 installation. With this, it is important to understand the impact of a flat network configuration on the various routers providing connectivity to other networks (e.g., those connecting WAN and LAN media).

In effect, WAN routers (e.g., SIPRNET) are inundated by LAN traffic not intended for disclosure on the WAN, thereby requiring the router to sample all traffic and discard most of that as intended solely for LAN use. This was quite evident when attempting to attach network monitors to ports on the SIPRNET router. The network analyzer would generate 4MB data files rapidly, mostly filled with traffic intended for the consumption of LAN nodes and much of it overhead and broadcast traffic. This large amount of traffic rendered data collection difficult in that collection disks would fill more quickly than was considered reasonable to alternate devices (move another analyzer in and archive the data off to a backup drive). When attempting to analyze this data, most of it appeared to be comprised of local broadcast traffic, other than that as actually intended for this collection effort. With the objective of observing traffic at the most restricted points (e.g., on/off ship exit/entry points to the WAN "cloud"), this traffic was generally considered extraneous. Moreover, while the evidence is somewhat inconclusive, it appears that the extraneous traffic might have precluded capture of some of the more significant on/off traffic intended for collection. In short, AGF 11 network observations appear to make an excellent case for many of the features found within IT-21 installations.

Communications Observations

PST

This point-to-point off-ship connection was not tested, however some system claims are that this system can work through SIPRNET. The Maritime Battle Center (MBC) desired to measure bandwidth used on the dedicated PST circuit to provide a comparison with bandwidth available on SIPRNET, however the attempt was too late to get permission from all concerned parties prior to the underway period.

WaveLAN / VRC-99

This communications pipe was dedicated and advertised as being so in any production version, thus no competition was perceived and no instrumentation planned. Afterward it was found that the competition for bandwidth within the ELB itself caused problems and instrumentation would have been highly enlightening. Should another opportunity avail itself, it would be desirable to tap whatever 10/100 base Ethernet media adjacent to these "wireless" LAN technologies is available.

SIPRNET

This WAN pipe formed a "classic" choke point and was thus the primary subject of instrumentation for this effort. Unfortunately, difficulties were encountered in determining all LANs feeding the SIPRNET connection. Moreover FBE-E network data collection planning occurred too late to obtain a version of the network analyzer capable of tapping the serial connection on the other side of the SIPRNET router. In so doing, much of the aforementioned extraneous traffic would have been filtered by the router, thus focusing collection on the area of interest.

An example of the SIPRNET data captured is contained in Figure 4[1]. This figure illustrates SIPRNET activity over the course of several hours during phase II. The data was obtained by tapping the Classified LAN feed into the SIPRNET router and then filtering out all but those packets with off-ship source or destination. Most of the activity indicated the use of HTTP protocols, generally associated with WWW browsing. SIPRNET activity also included HTTP chat sessions originating from WeCAN participants however this is illustrated in a separate graph. For reasons yet to be established, the graph also indicated two periods of total inactivity. This indicates one of two things: (1) a SIPRNET outage or (2) the inability of the network analyzer to cope with the ambient traffic load on the Classified LAN feeding SIPRNET (ostensibly the AGF 11 backbone for this type of data). The results support either one of these conclusions. Particularly noteworthy is the length of the "drops" in activity. There appear to be gaps of over 30 minutes in each case. Figure 5 illustrates the Classified LAN activity with fewer subnets filtered, allowing a greater degree of internal LAN traffic to be plotted. This analysis was run against the same sample data set as figure 4 and illustrates that large data spikes (of up to 6.4 Mbps) coincided with those periods where external traffic was not collected by the data analyzers.

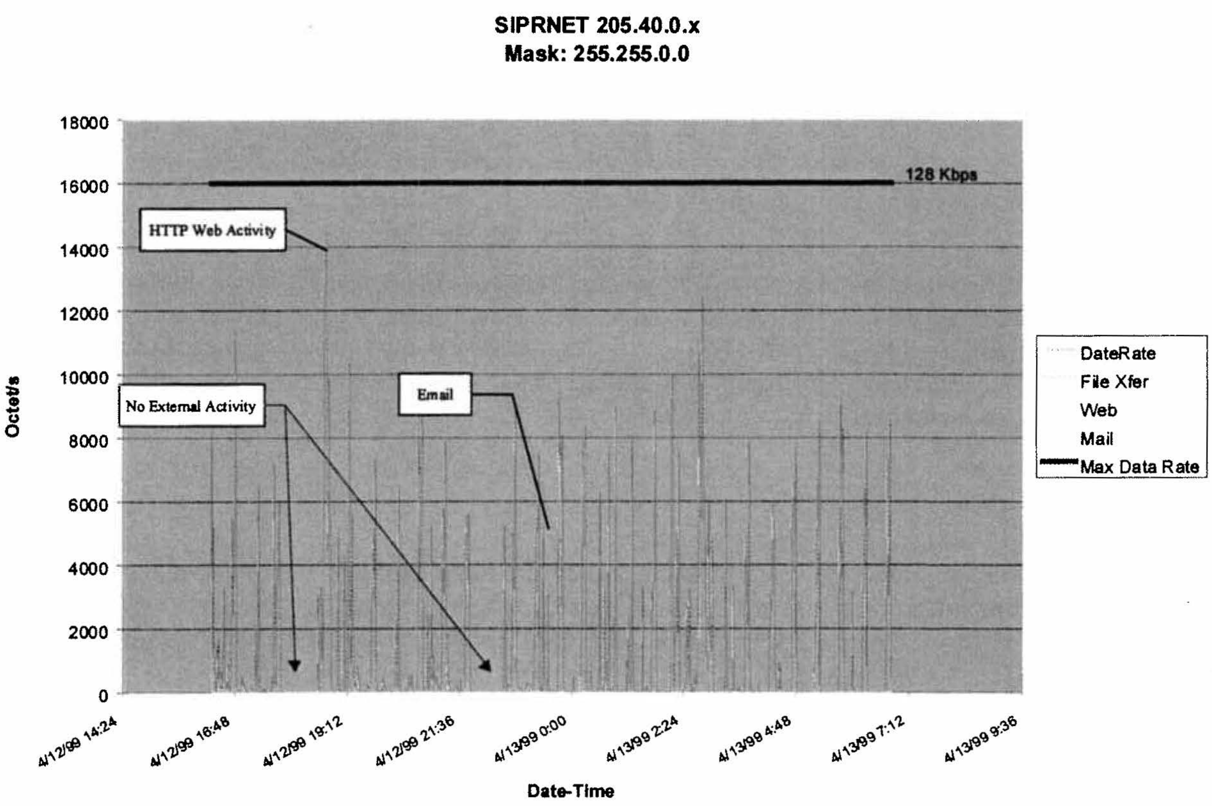

Figure 4. SIPRNET Activity Example from Phase II

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[1] When observing these scatter-chart graphs, note that bandwidth usage is represented in Octets (Bytes or Kbytes) along the Y-axis and that time is represented along the X-axis. Statistics are generated in bytes versus bits by the collection and analysis programs. When converting to bits (e.g., Kbytes/s to Kbps), simply multiply the value along the Y-axis by 8.

Classified LAN

The AGF 11 "classified LAN" was instrumented. The classified LAN essentially comprised the AGF 11 backbone. This backbone consisted of 100baseFx Ethernet fiber media, which ostensibly carried most shipboard classified traffic and thus provided connectivity for most shipboard classified workstations to the SIPRNET. As previously noted, this LAN evolved into a flat network, without the aid of multiple segments as typically provided by modern switches. Therefore, all attempts at collection were inundated by the large amounts of ambient traffic on the net. Figure 5 illustrates a portion of that large traffic load (still with significant filters applied). While outside the scope of this analysis, actual loading would likely have been significantly higher, without the application of filters.

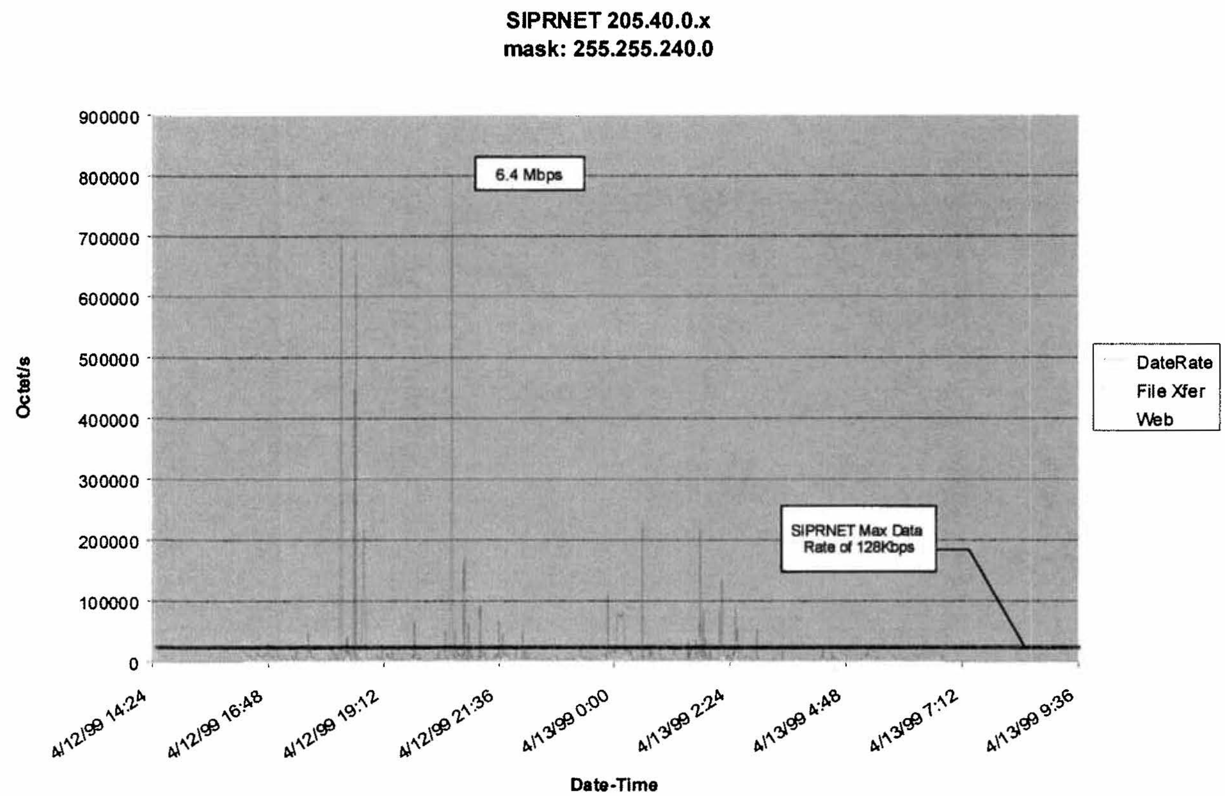


Figure 5. Partially Filtered Classified LAN Traffic Showing Peaks

Other Observations

A large number of dedicated communication pipes were encountered in this experiment. The actual burden on SIPRNET seemed minimal, but if traffic was on dedicated pipes only for experimental convenience and is intended to go out on SIPRNET in any operational installation, real analysis will have to be performed. For example, WaveLAN used 2Mbs and PST supported 10 Mbps. Actual use was not measured (but apparent saturation of WaveLAN with video at one point implied that all 2 Mbps were used on that pipe.)

JAOC

JAOC instrumentation was essentially pursued to obtain LAWS data thought to be coming in through that space. Attempts to get traffic between JAOC systems, however, were frustrated by a "smart" hub, which filtered all traffic not intended for the specific port tapped. Unfortunately, this was not known early enough for it to be avoided. The same problem occurred on a larger scale during phase I, when many of the network data collection taps were applied to "smart" hub ports. Figure 6 illustrates the network activity visible to the analyzer via the "smart" hub port. Note that virtually all traffic consists of UDP broadcasts. Thus, no on/off ship activity was observed due to the type of the hub involved.

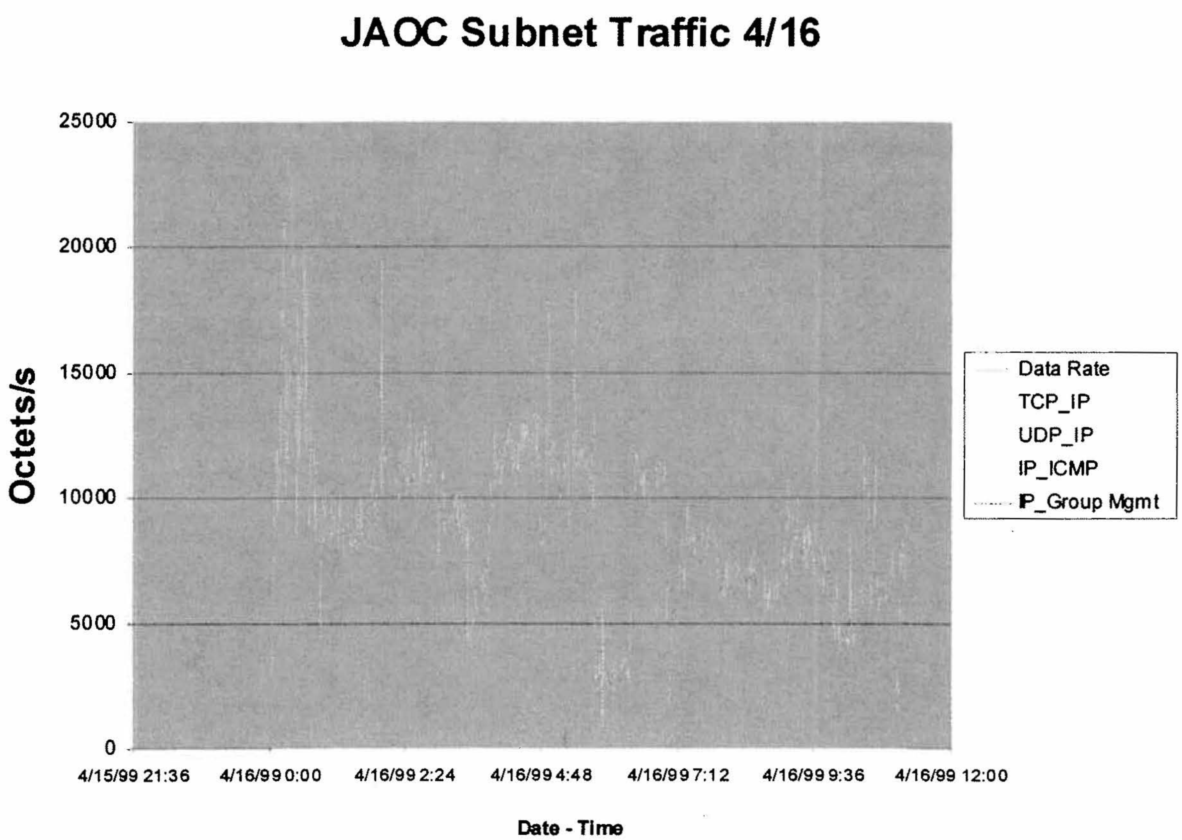


Figure 6. JAOC Network Activity Captured Illustrating Broadcast

Collaborative Planning

Much of the network data collection performed during phase I was oriented toward Dynamic Collaborative Planning (DCP). This involved the continued evaluation of bandwidth utilization as incurred by COMPASS services during DCP. It also provided an opportunity to instrument the MOSC and observe DCP operations from the "support side". With regard to DCP, MOSC serves a number of functions:

(1) It provides a cadre of experts and associated services concerning topics such as modeling Chemical / Biological weapon dispersion, as well as the simulation of other such tactically relevant events.
(2) It provides a central point of simulation scenario-control TMD exercises, as required.
(3) It provides support with regard to DCP troubleshooting, as needed during exercise conduct.
(4) It provides actual connectivity services in support of virtually all events involving COMPASS DCP.

The fourth item above will be the topic of continued discussion in this area. One of the by-products of this collection effort has been an increased understanding of the role of the MOSC as a "DCP forwarder". By way of background, COMPASS DCP is currently being exercised over SIPRNET. Many of the services involved in this valuable capability require the use of non-addressed, unacknowledged protocols (e.g., UDP). Such services include voice and video, where acknowledgements would otherwise interrupt the data stream. Thus UDP protocols are required. Unfortunately, these can only be delivered either via broadcast or through a "limited scope" broadcast, known as multicast. Multicast employs a special subnet mask (known as a class D address), which is assigned to all participating nodes. While this sounds like a great solution, it turns out that SIPRNET does not allow for the use of this protocol. This appears to be due to its routers not being configured to handle multicast. It may even, in fact, be a matter of policy that such messages are discarded, since outside users, with knowledge of the multicast address(es) could induce "broadcast like" traffic in an attempt to deny service. Regardless, SIPRNET does not, in its current state accommodate multicast.

In spite of this limitation, SSC-SD's MOSC personnel devised a solution, using a protocol over multicast designed to transport multicast packets in and out of the established, nationwide multicast backbone (a.k.a., mbone). This protocol involves the use of an outside Internet Protocol (IP) wrapper, referred to as "IP-in-IP". These packets are used to traverse "connections" established over media not designed to forward multicast packets, known as "IP Tunnels". This creative solution was quite successful, in that COMPASS services have been demonstrated at various distant locations using existing SIPRNET media between workstations configured with the IP tunnel connections. A more detailed description of the problem with multicast over SIPRNET is contained in Appendix C, along with a description of the IP tunneling protocol.

One of the more interesting aspects of the use of IP tunnels is the requirement to establish a connection between pairs of participating nodes. A tunnel forms a direct point-to-point connection, and thus must be established between each pair of nodes participating in the "conversation". For COMPASS DCP this is handled using a Multicast Route Server (via mroutes entered at each participating site). While duplication of traffic is unavoidable in such an environment (see appendix C), the use of a single site to "relay" such point-to-point broadcasts does mitigate this to a large degree, at least from the standpoint of most individual participating sites. The solution thus far has been to use the mrouter at the MOSC (hosted in the "greyhound" workstation) as the "relay" point. When any participating node transmits DCP multicast data, it actually does so via its IP tunnel with greyhound. Greyhound, in turn then retransmits this same data out (in the order received) on each of its IP tunnel connections to all other participants. While this form of relay does induce noticeable latency (audible delay of up to 1 second), it does ensure that the packets are received in the same relative time sequence at each terminating node, thus providing a reasonably high quality receipt of voice data.

Overall, however, this use of tunnels does drive up bandwidth usage. At the MOSC, in particular, each voice "broadcast" results in voice traffic across each of the tunnels over SIPRNET. In other words, if there are 5 participants (besides the MOSC), SIPRNET traffic is increased fivefold.

This can be significant, when considering that the voice compression technique used for COMPASS employs up to 13Kbps per node (five nodes could use up to 65Kbps of SIPRNET bandwidth). Moreover, should an individual site employ multiple direct connections to the greyhound mroute "server", the traffic would be increased by an ordinate amount (resulting in a duplication of on/off ship bandwidth usage). While the policy is to have a single mroute-configured station at any COMPASS site (which would "unpack" the multicast packet and forward it to other multicast nodes aboard), this type of duplication was observed on the USS BLUE RIDGE (LCC 19) during FBE-D. It's likely that this may have been used as a work-around, since there were some difficulties encountered setting up multicast via the IT-21 switches on board, however, it is an example of how this method, while effective can result in increases in bandwidth usage.

Figure 7 illustrates the capture of IP-tunneled multicast during phase I of FBE-E. This DCP session involved IP-tunnels set up to a handful of stations. Note the actual bandwidth usage by the tunnels far exceeded the 13Kbps that would otherwise have been required by the digital voice compression employed. It should also be noted that this graph uses a significantly different time scale than others represented within this report. This was for the purpose of observing activity associated with "microphone key" activity during the DCP session.

While use of the MOSC as a mroute / IP tunnel "server" simplifies the use of tunnels and alleviates the even greater bandwidth usage that would otherwise be required at individual sites (having to maintain numerous tunnels to other individual sites), it does carry with it the potential for failure. Assuming an outage at the MOSC or failure on the workstation handling the tunnels, all DCP connectivity would effectively be disturbed, until alternate tunnels could be established. While not impossible, this would likely prove inordinately difficult for deployed personnel afloat. An alternate set of mroutes or tunnels should be established for such contingencies, to provide a more robust system within actual operational environments.

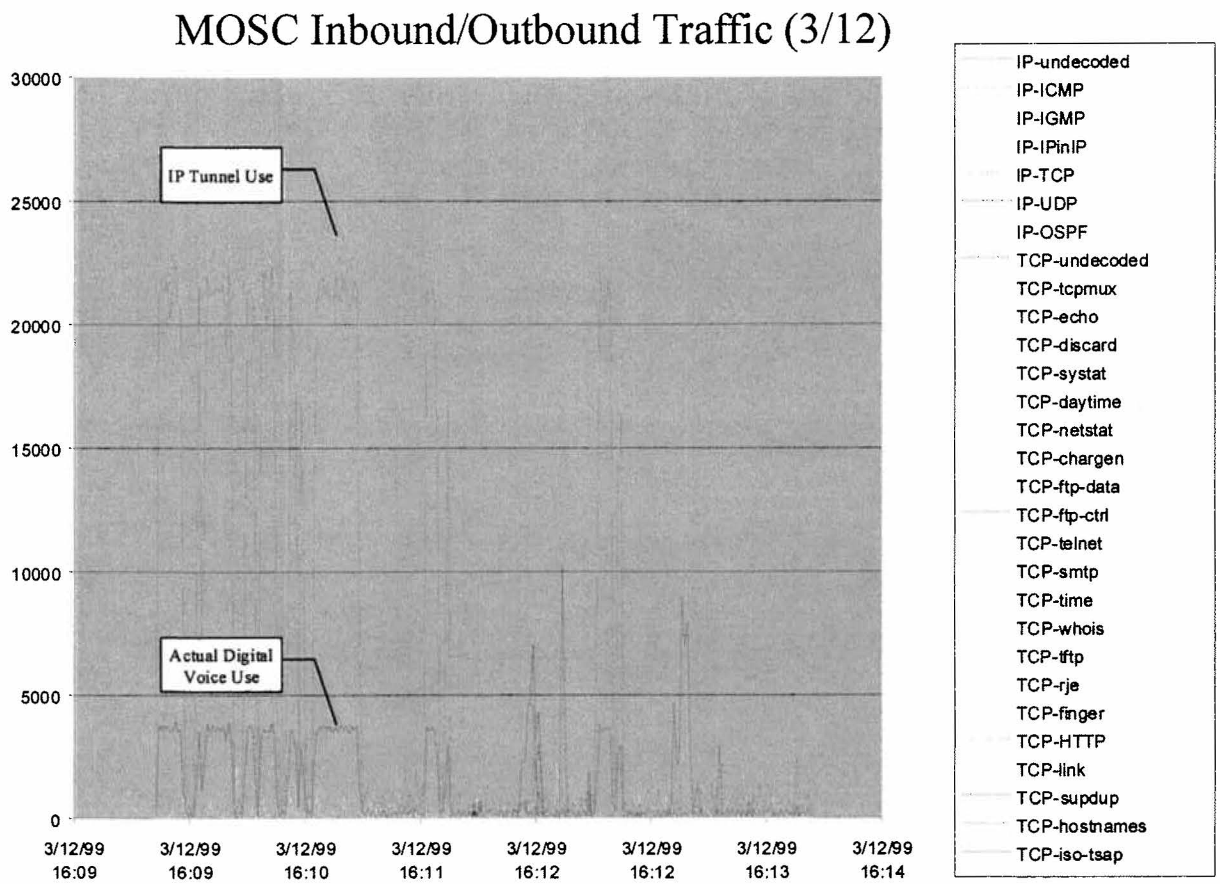


Figure 7. IP Tunnels As Observed in SSC-SD MOSC (3/12)

For planning or relatively slow-tempo operations, "chat" (transmitted typewritten text) appears to be a viable, low-bandwidth alternative to digital voice. Moreover, chat also tends to resolve ambiguities resulting from otherwise unclear transmissions, which cause the recipient to transmit "say again" in response (adding further to the bandwidth consumed). The ASW Cell (see next paragraph) employed chat successfully, given the relatively slow-paced tempo of operation typically encountered in that environment. Chat, however, does not always compare favorably, given the environment.

During one FBE debrief, personnel indicated that attempts to use chat for "call for fire" coordination (via LAWS) resulted in slow reaction times. In this case, the additional bandwidth required for voice transmission would have been preferable to the operational impact of increased reaction time.

ASW Cell

The ASW Cell extensively employed the WeCAN tools for collaborative planning as well as a means to almost entirely of HTTP protocol Web traffic. During most periods, where chat was employed, the traffic averaged well under 2Kbps. Peaks are representative of graphic data and other file transfers as required in support of the ASW problem. This data was collected via the JMCIS network tap, using filters to/from external sources in/out of the ASW cell.exchange files and images. As previously noted, WeCAN employs the WWW HTTP protocol as its transport mechanism. From the standpoint of the ASW Cell, WeCAN chat was employed quite effectively. Bandwidth usage for chat itself was relatively low, leaving greater reserve bandwidth for other data transfers. Moreover, ASW Cell participants not only found chat adequate for the op-tempo, but also were quite enthusiastic with regard to its utility. FBE-E distinguished itself as highlighting the op-tempo as a basis for the selection of chat or other means to disseminate information in "real-time". Figure 8 illustrates the filtering of ASW Cell data either received from or destined for off-ship sites. This data is comprised

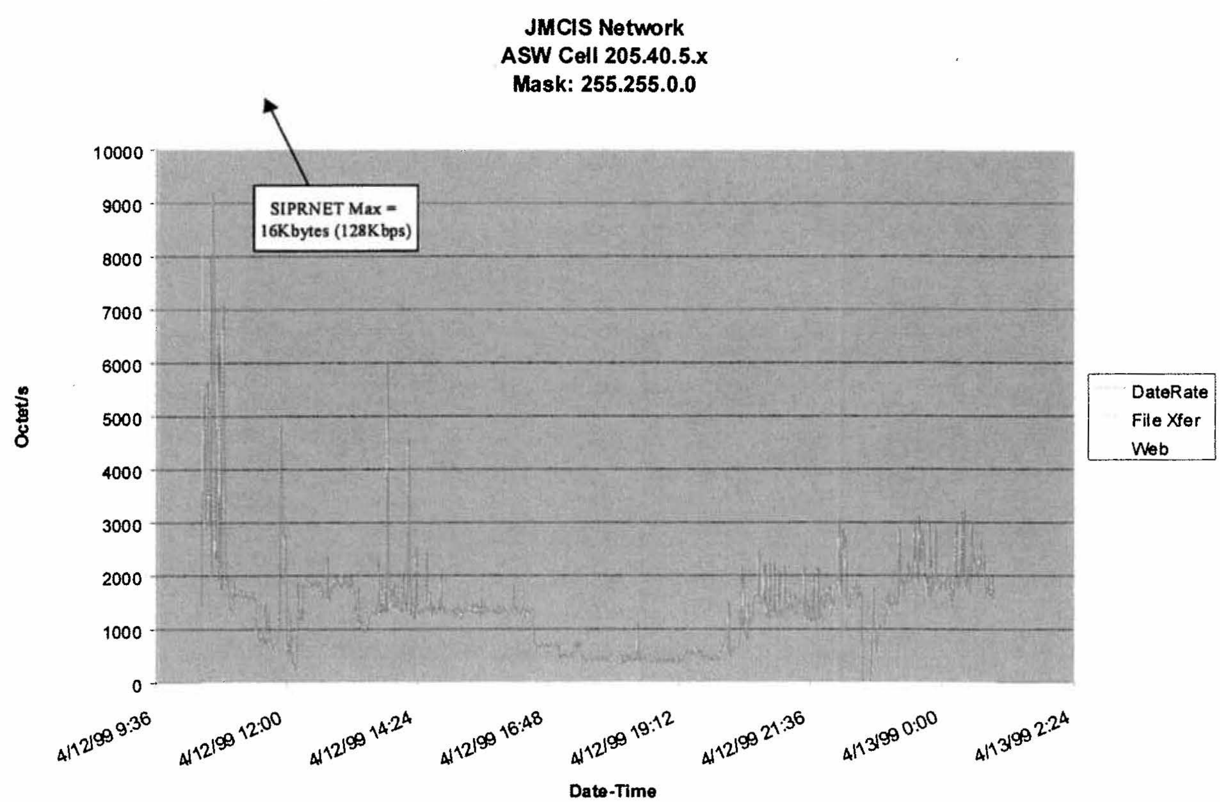


Figure 8. ASW Cell Contribution to SIPRNET Bandwidth Usage

Conclusions and Recommendations

Given the observations noted above, a number of conclusions can be drawn with associated recommendations for future application. This paragraph provides a general summary to that end.

One of the more notable observations, while not new, was that "chat" is conservative of bandwidth and, when tactically viable, should be preferred over voice. Other advantages inherent in chat sessions is the resolution of ambiguities often found in speech – text is clear and can be clarified in relatively short order (with little cost in bandwidth) as necessary.

Network administration tools were essential in the identification of the AGF 11 configuration within phase II. Moreover, experience with the AGF 11 network indicated that management and maintenance of the ship's LAN and WAN components would be virtually impossible (given the large number of users) without such tools. Thus net administration tools should be an integral part of any network installation. However, there needs to be a database that relates IP or MAC addresses to shipboard location and tactical system names and / or functional application, so that depiction of network elements is tactically meaningful. This would greatly aid in the ship's use of such information, which otherwise, by its very nature is rendered somewhat cryptically.

There is clear contention for bandwidth on some nets. This situation seems to change with mission and operations of the ship. It therefore seems that management of bandwidth on and off the ship is much more dynamic than in shore-based enterprises. In addition, the view afforded of bandwidth users by typical network tools is in terms of IP or MAC address rather than in terms meaningful to a tactician or network administrator trying to adjust the network to support a specific tactical requirement.

Appendix A – Lessons Learned

Packet-Level Analysis

In spite of previous advertisements, some packet data needs to be collected by the network analyzers in addition to packet headers. This is because some of the information required collection personnel to understand the source and application of the packet is included as "data" immediately below the header data. The "data" is actually header data from the highest (application) layer in the ISO seven layer protocol stack because some protocols (e.g., "real time protocol—RTP") use the upper layer for header type information.

Network Analyzer Capacity

Data collection for as little as 24 hours fills up the network analyzer hard drive requiring that the data be zipped for storage (compression about 4:1). After the data is zipped, it is more difficult to "pre-process" to remove data as required by C3F ADP security. In addition, the "data" removed by pre-processing is actually required for effective analysis (see above), so if pre-processing is done prior to compression, the retained data has lost needed information. Once several days of high capacity data is collected and zipped, the disk is too full to inflate a zipped file for pre-processing. Thus, for effective processing, data has to be reduced and analyzed prior to pre-processing and zipping. However, since the data is SECRET, it can't be readily transferred to another computer for processing. Another network analyzer was substituted when analysis had to be performed during execution. If, however

High Bandwidth Usage Impact on Key Subsystems

Although it was not instrumented with network analyzers, the ELB WaveLAN exhibited classic bandwidth starvation. Voice and file transfer communication between LAWS on Coronado and John Paul Jones was precluded (even pinging didn't work). When video transmission ceased over the WaveLAN, pinging worked and WeCAN, voice, and other comms passed through. The WaveLAN pipe could really benefit from bandwidth management.

Advance Network Instrumentation

Need to analyze the networks well prior to experiment. It would be useful to instrument the networks well prior to the experiment to: (1) validate instrumentation and tap point, (2) familiarize shipboard personnel with operation, use, and information from instruments, (3) gather sample data to validate reduction routines and, in particular, subnet and system filters, and (4) identify and correct existing network traffic and configuration issues.

Serial Network Media Monitoring

Need to adapt to serial data format from routers to SIPRNET. Could be useful to use a real-time analysis device such as a packet shaper for better information to support the FBE during execution.

Addition of Network Administration Tool

Need to add net admin tool into one FBE to determine impact of database creation and maintenance.

Appendix B – Network Bandwidth Management

This appendix addresses the capability of commercial off-the-shelf (COTS) bandwidth management products and the applicability of that capability to on / off board shipboard digital communications.

Capability

There are currently several COTS products that control the use of bandwidth in a network by a very flexible number of filter criteria based on measurable parameters in the communications message stream.

Control of message bandwidth use can be both on a basis of priority and of rate control. This is important because Navy tactical traffic cannot be controlled on the basis of priority alone. An application with high priority can command bandwidth to the exclusion of all other applications when only a portion of the bandwidth would be sufficient for the priority application leaving the residual for others.

Rate control coupled with priority control provides the flexibility for a more effective bandwidth control strategy.

To define a bandwidth control strategy, you need to:

Identify traffic characteristics and behavior
Classify / identify traffic according to source, application, and minimum latency, latency variation, or bandwidth requirements.
Devise a policy to control access and allocation of bandwidth on the basis of the identified use.

Navy Requirement

Bandwidth management could greatly benefit shipboard systems. For example, during FBE-E the ELB system communications between USS Coronado and USS John Paul Jones was via a Wavelan wireless LAN. When the 2 Mbs bandwidth was used for streamed video, the video consumed all available bandwidth. Attempts to pass simple files using TCP/IP failed because there was not even enough leftover bandwidth to support consistent "pings" across the interface. As soon as video transmission ceased, other transmissions passed through. This is clearly a case where a bandwidth management tool with appropriate strategy could have allowed concurrent operation of all applications.

Traffic classification, identification and bandwidth allocation policy development for shipboard applications is different from commercial enterprise, but the controls afforded by the COTS bandwidth management products are applicable. Tactical applications require significant bandwidth control flexibility. Tactical applications have a wide variety of missions and use a wide variety of protocols with mixed tolerance to packet loss, latency, and latency variation.

It is not apparent *a priori* what the exact bandwidth management strategy should be, or even if a static strategy is satisfactory. It may be necessary to adjust bandwidth management strategy as the tactical situation (mission requirements and communications channel operability) change. If the strategy turns out to require dynamic control, then it seems best to initially leave that control to a human while patterns of operation are experimentally determined that later may permit automated control.

Bandwidth management strategy requires tactics and procedures, probably best developed experimentally, as do communications use in any other area of warfare. Moreover, as in other warfare areas, any management strategy is susceptible to information warfare, and that susceptibility should itself be evaluated during the experimental process.

Recommendation

Bandwidth management is a requirement for successful shipboard digital communications in general and for FBE in particular.

Current COTS bandwidth management products should be investigated to

1. Learn all factors associated with their implementation (in part by learning from the adversarial presentations of competing vendors.)
2. Pick the "best of breed" for Navy application.

The selected product could be evaluated in a land-based environment if a suitable mix of protocols and applications can be provided. Whether evaluated land-based first or not, the selected product should be installed on an FBE ship for experimentation with trial strategies.

Postscript

This technote is directed at on / off board communications. Evolving warfare techniques call for the transfer of large bandwidth products within the ship. These bandwidth requirements also warrant attention and management, but are left to future FBEs. In addition, no fleet-wide communications bandwidth management has been investigated.

Appendix C—Network Administration

The current situation is that networks aboard Navy ships generally do not have network administration tools or strategies. For small deck ships, where systems are not changed too often and personnel and their ADP tools do not move within the ship too often network administration may not be a major issue. However, on large deck ships where systems frequently change, personnel spaces are realigned, and whole groups move on and off the ship with associated ADP to support varying mission requirements, network administration is an on-going issue.

Network administration requires both tools and a strategy for their utilization. The strategy must address both utilization of the network administration tools (NATs) and the procedures to be used in managing ADP assets on the networks.

USS CORONADO has introduced a commercial off-the-shelf (COTS) NAT by Computer Associates called "UniCenter". The presence of UniCenter during Fleet Battle Experiment-Echo (FBE-E) presented an opportunity to evaluate how such tools might be introduced to administer the flow of ADP equipment on and off the ship's networks for the FBE—arguably a worst case example of embarked force impact.

This appendix proposes one way in which the UniCenter NAT could be utilized to support administration of network assets in a situation such as presented aboard USS CORONADO. Attention is paid to asset management and connectivity monitoring. The experiments proposed herein also establish the background for bandwidth contention management within the ship.

While the UniCenter software is referenced because it was on Coronado, there is no intention to endorse the use of any specific product. In fact, the research of all available products of the type should be conducted to determine the best features from all for shipboard applications.

Connectivity Determination

The first challenge in network administration is to establish a picture of the network connectivity—all the net units[2] on-line and how they are connected to each other. COTS NATs are typically software running in a PC attached to the network. They search the network to discover the on-line units by their media access control (MAC) address and / or assigned Internet Protocol (IP) address. Requests to on-line units are responded to in Simple Network Management Protocol (SNMP). All commercial units of interest support SNMP. There may be military systems attached to the network which do not support SNMP, however most military systems attached to networks are based on COTS processors and ADP equipment which do support SNMP.

On Navy ships, IP addresses are usually assigned dynamically when a unit logs on and kept for the duration of their log-on (although it is possible for a maximum time for IP "rent" to be implemented.) Therefore, to avoid ambiguity, the MAC address will be used for reference in this technote. Some components such as "dumb" hubs or passive PCs (i.e., those used as network analyzers) will not provide a MAC address. This does not significantly impact the administrative problem. Network administration policy should also ensure that all units capable of being assigned an IP address are assigned an IP address to facilitate the NAT unit discovery process.

[2] A "unit" herein is a CPU, switch, smart hub, router, or other device attached to the network.

Human Factors

Most COTS NATs provide a graphical interface to reflect results of the unit discovery process. The discovered units are presented as they are connected to each other in a hierarchical fashion. A high level view is presented first in which major subnets are represented by symbols. Clicking on a subnet symbol explodes the view of that subnet to the next level, which may also include subnets as symbols. The sequence continues until the "drill-down" process arrives at units, represented by their MAC or IP address, on the subnet terminal segment.

While the drill-down process works well, the representation of units by their address is not very meaningful. In performance of his role, a network administrator generally has to account for all attached units, determine where a problem exists, determine what units will be affected by an upgrade, determine where a unit is located, etc. The administrator thus really needs to know the type of unit, its name, its use, and where it's located (space frame number and name). Moreover, this information needs to be available and organized for the current application, by space, equipment type, etc.

This information requirement suggests a supporting database to the NAT connectivity discovery tool.

(Even greater benefit could be gained from information about which terminals / ports are actually connected and from a communication load model for connection. These latter data, while useful, require considerably more effort to enter and maintain. They are therefore left to a latter evaluation.)

Adjunct Database

Most COTS NATs contain an adjunct database for just the purpose described above. Such a database is called a Unit Locator and Purpose Database (ULPDB).

The main challenge in creating and maintaining a database is to minimize the effort required and work the effort that is required into the normal procedures for network administration. The process used should minimize induced errors and the system should be tolerant of the few errors that are induced.

The actual database format is usually dictated by the COTS NAT. The way in which the database is used, however, is up to the ship to describe. The following describes one way that a database maintenance process could be defined.

Initially, all units have to be defined to the database. There is no substitute for this effort. Each unit is referenced by its MAC address. The MAC address for a unit is its reference and the item by which the database is indexed. Thus each unit's MAC address has to be determined. The best time to accomplish this is upon initial network installation. Beyond this time, there is little work-around to determining the information unit by unit. Using a laptop to enter the information at the site of the unit, and then transferring it to the NAT computer later, could facilitate the process. (Even, better, the laptop can host the NAT so that the information is entered directly into the NAT.)

After initial database setup, the process consists of maintaining the database as units enter or leave the ship. That process can be that the owner or installer of the unit checks with the network ground before installation / de-installation. At that time, the network administrator can demand the required information. For units that attach to the network without "signing in", a query will show them attached and the network administrator can find them and complete the information.

Since a sign-in of sorts is required for ADP security, the ULPDB can be updated in conjunction with ADP accounting so that the effort further integrated into the overall accounting required.

Physical Connections And Audits

The network administrator needs to perform queries on the database such as the following:

What are all the units in space *xx*?
What are all the units of type *xx*?
What and where are the units associated with purpose *xx*?

Another query important to the network administration is to find all MAC / IP addresses not listed in the ULPDB and the units, to which they are attached, possibly organized by connected unit location. The purpose of this query is to find units that have escaped the accounting process, find them, and enter their data if they are valid additions.

Queries

In order for the queries described above to work, the values of the parameters unit type, name, purpose, location number, and location name need to be consistent. The way to ensure value consistency is to provide a user interface for entering unit data that selects parameter values from lists (i.e., not by literal entry). The network administrator should maintain the list for each parameter

Concept Validation

FBE operations are very dependent on good network administration. In addition, it would be useful for FBEs to demonstrate the utility of a full NAT implementation in support of shipboard network administration. A NAT should be purchased and installed on a big deck ship involved in a future FBE. Full implementation of the NAT for FBE should be planned with the ship in time for the target FBE. The NAT should be used to automatically identify and illustrate the network configuration in support of FBE.

This effort would simultaneously validate the network administration strategy and illustrate the utility of the NAT in support of a dynamically changing network environment.

The ability to clearly define the network environment is a necessary first step to attacking the network bandwidth management challenge.

Issues

Most ships have multiple networks. There are multiple networks to support multiple security levels (unclassified, SECRET, and SCI). In addition, when a ship receives a new network (e.g., IT-21), it frequently retains preexisting networks. It is not clear that a single NAT can maintain information on multiple networks. The SCI network is probably more stable in configuration and better administered simply because of the requirements at the higher security level. The most important network to administer is the SECRET network (usually connected off-ship via SIPRNET) because it is used for tactical purposes. (Although NIPRNET is occasionally used to support FBE, it's used as a convenience; the NIPRNET does not support tactical requirements.) Legacy networks are usually reserved for internal administrative purposes. Therefore, if only one network can be administered with a NAT, it should be the SECRET network.

Summary

Network performance is critically dependent on good administration. Network administration is dependent upon visibility into the network connectivity of the moment. COTS network administration tools exist which greatly facilitate network administration. One such tool, partially implemented on USS CORONADO, demonstrates its use in a shipboard environment. More complete implementation would materially improve configuration of shipboard networks for FBE and demonstrate the utility of full implementation for routine shipboard network administration.

The next FBE should include complete implementation of a COTS NAT in support of operations.

Appendix D – Multicast over SIPRNET

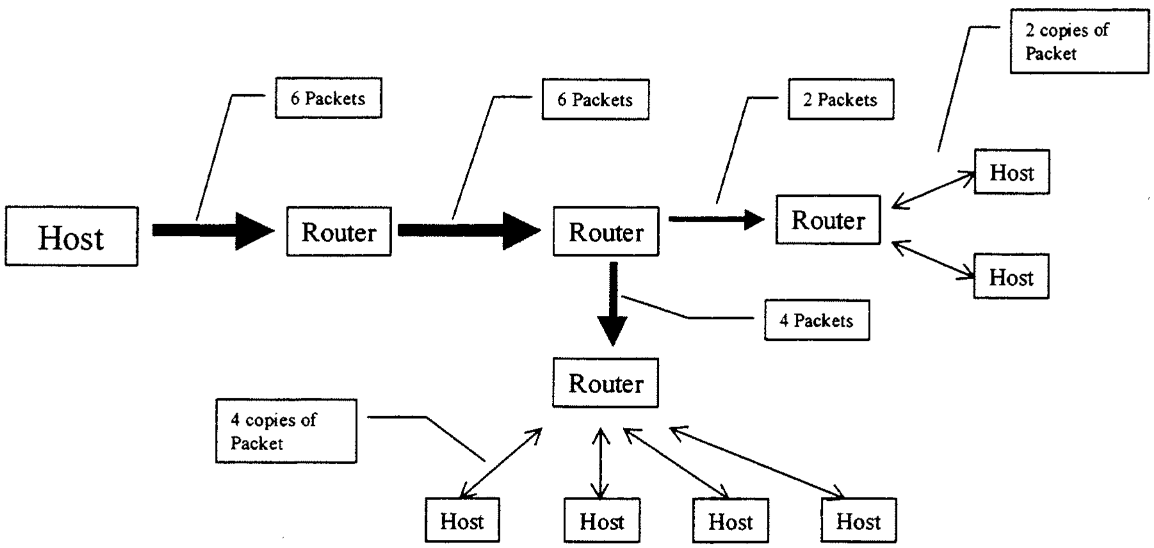
Network data collection and analysis for Fleet Battle Experiments (FBEs) have been supported since FBE-C. As the process of network data collection and analysis continues to be refined, additional information regarding system use of various shared Wide-Area Network (WAN) media, in particular, is uncovered. This appendix describes such information, which was uncovered as a by-product of continued analysis for FBE-D, TMDI-98, and FBE-E. As network data collection and analysis continues to be integral to the FBE process, information observed in earlier exercises can be analyzed with greater clarity and understanding, thus facilitating an increased understanding on the part of fleet network users and planners.

This paper describes the results of network bandwidth utilization analysis associated with Dynamic Collaborative Planning (DCP) using COMPASS middleware in conjunction with various UNIX-based planner workstations (e.g., AFMSS, TAMPS, BMDO CAPS).

Discussion

DCP, by its very nature, employs a set of tools that necessitate protocols that differ from a typical file data transfer (e.g., email, FTP, HTTP). Internet Protocol (IP) file transfers typically employ Transmission Control Protocol (TCP/IP), which addresses each message to a specified recipient and processes acknowledgements. In the event of a failure to receive acknowledgment from the receiving node, the sender simply retransmits the "lost" packet. Thus TCP/IP is considered a "reliable" protocol. TCP/IP is well suited for the transfer of data files, where all data must be received exactly as sent. Portions of the file(s) lost in transit are merely retransmitted. Unfortunately, awaiting acknowledgment and re-transmitting messages does not support more time-critical traffic, such as "streamed" video and audio.

Audio and video as all data destined for transmission via networks must be wrapped into network messages or packets with a maximum length based on the type of physical media employed. These types of transmissions involve continuous, real-time broadcast of the intended information and are thus not suited to the interruptions imposed through the use of acknowledgments and retransmission of data. Such data must be processed in the same timeframe and order it was sent or it is rendered unintelligible. Therefore, audio and video information is typically forwarded using an unacknowledged, "unreliable" method, known as User-Datagram Protocol (UDP/IP). (Unreliable within this context indicates that since the packets are not acknowledged, their delivery cannot be guaranteed.) Moreover, within DCP sessions, one site typically intends to disseminate information to several sites simultaneously, thus necessitating some method of transmission to multiple addresses in real-time. COMPASS DCP also possesses the capability to provide real-time simulation and modeling in support of planning (e.g., casualty prediction assuming the use of Weapons of Mass Destruction [WMD]). Several nodes must also typically receive this information simultaneously for effective collaboration to take place. UDP/IP messages are typically addressed to a broadcast address, which allows them to be sent to several nodes simultaneously. This has the desirable effect of supporting DCP, however, would also impact other nodes on the network as the broadcast were propagated throughout the entire network. As nodes receive broadcast messages they attempt to "unpack" the message and process its content. This effort wastes processing for nodes receiving such data unintentionally (such nodes can be numerous, depending on the size of the network relative to the intended audience). Were such data to be addressed, the packets would need to be repeated for each addressed node (thus increasing the related traffic by 1*h, where h is the number of DCP hosts on the network). The theoretical impact of such addressing is illustrated in figure 1. This problem is addressed through an additional protocol known as Multicast.



IP Tunneling of Multicast Packets on SIPRNET

IP tunnels, while reliable, ostensibly create additional network traffic across SIPRNET. This occurs in a couple of ways. The process of applying IP-in-IP wrappers itself ostensibly creates additional traffic (additional headers are applied to packets actually sent across WAN media). While not generating an inordinately large amount of traffic, the use of additional encapsulation does impact bandwidth usage. More significant, however, is the use of multiple point-to-point connections to handle the "broadcast" of information to multiple hosts. Figure 3 provides a simplified illustration of IP tunnels applied to SIPRNET.

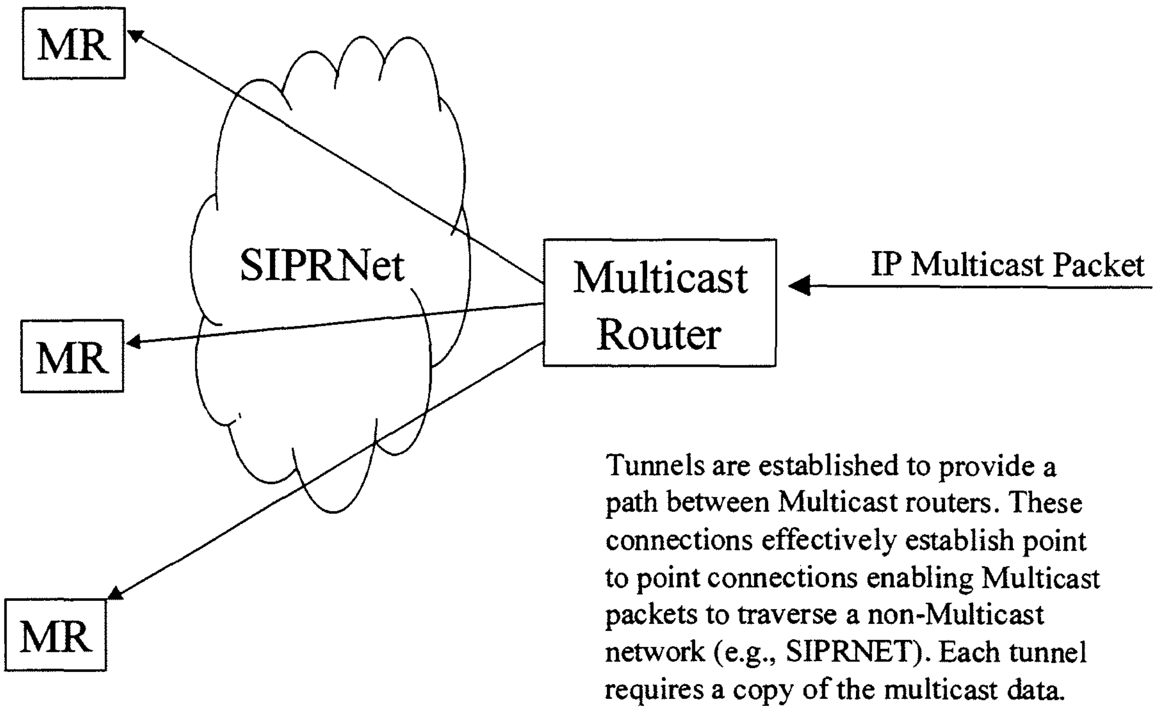


Figure 9. IP Tunnels Across SIPRNET

On the surface, the use of tunnels might seem relatively innocuous, since SIPRNET is designed to handle high-bandwidth users. The problem, however, is not in employing multiple tunnels across SIPRNET, per se, but rather with the use of multiple hosts configured as "multicast routers" at individual sites. When this occurs, the results are very much akin to the replication of packets indicated in figure 1, where a separate stream of data must be forwarded to each host. Essentially, each packet is replicated at the multicast router host for each connected host. This traffic replication might cause one to wonder why tunnels were ever employed with multicast traffic, since they tend to obviate some of the advantages inherent in multicast protocols. The IP tunneling protocol was actually intended as a means by which multicast routers could forward between multicast backbone or "mbone" routers, for the purpose of transporting multicast efficiently between established multicast routers. SIPRNET, however, does not actually employ the established (and evidently expanding) mbone and as such needs to establish IP tunnels between all multicast hosts.

The establishment of IP tunnels requires the entry of multicast routing information or "mroutes" within each multicast host (mroutes can only be established on UNIX workstations). Assuming either the use of multiple multicast workstations on the same network or a multicast-configured router at the individual site, the multicast host can strip off the IP-in-IP headers and forward the multicast packets to other DCP stations within the confines of that site. If, however, a non-multicast router exists between the two (or more) DCP stations, each one must be setup as a multicast router, which has the effect of increasing traffic on and off the ship by an ordinate amount, given multiple workstations.

Since SIPRNET does not route multicast packets, individual connections must be established between all participating sites. On a "multicast subnet" with multiple sites, this would prove impractical. Therefore, a single site is typically selected to be the multicast router for the WAN. During recent FBE events (including TMDI-98), the SSC-SD MOSC router "greyhound" was employed as the WAN multicast router. In this capacity, the WAN multicast router functions as a "relay site", or "hub" with IP-in-IP connections established to all other participating multicast sites. To SIPRNET, each transmission appears as a generic IP wrapper, with the content of the encapsulated traffic unknown. Upon its receipt by "greyhound", the wrapper is stripped off and repackaged for each of the other IP-in-IP connections. The impact of this method is that it increases traffic from the hub site by a substantial amount. This works relatively well in cases where each site has only one mroute host. As previously noted, however, the number of mroute stations at each site increases traffic by an ordinate amount.

Another impact of using mroutes and IP-in-IP encapsulation within a DCP environment is that of the system setup. Mroutes must be properly configured for the environment in which the host will be participating. This information is typically set up within the appropriate UNIX directories. While it is relatively straightforward for most competent UNIX users, such users are not typically available within the shipboard environment. Given the potentially dynamic nature of such setup, ongoing support involving personnel other than ship's company may be required to ensure platforms are properly configured, regardless of their operating environment (e.g., ships in company, operating Area of Responsibility, etc.).

Conclusions and Recommendations

Multicast via IP tunneling has generally proven adequate to support an exercise environment. To the extent that information systems prove reliable under more critical operating conditions, the use of this technique should support DCP. Observations to date, however, have indicated that its use of bandwidth is far from optimum. This should be addressed as follows:

Ensure that all sites, comprised of multiple DCP workstations, are configured with only multicast routers between the mroute host and other workstations. Should workstations be located on separate LAN segments or subnets, then any router or switch between the nodes must be configured to support multicast.

SIPRNET's architecture does not allow for the use of multicast routers. DCP requirements should be presented to SIPRNET's governing body and a plan to modify and/or upgrade SIPRNET routers developed and implemented at the earliest possible date. Multicast protocols will be required for many future network applications, involving streamed video and audio and should be accommodated via either SIPRNET or other similar means as soon as practical.

Appendix E – Acronyms and Abbreviations

Acronym	Definition
ADNS	Automated Digital Network System
ADP	Automated Data Processing
AFMSS	Air Force Mission Support System
ASW	Anti-Submarine Warfare
ATM	Asynchronous Transfer Mode
BMDO	Ballistic Missile Defense Organization
BW	Bandwidth
CAPS	Commander's Analytic and Planning Simulation
CBW	Chemical and Biological Warfare
COMPASS	Common Operational Modeling, Planning and Simulation Strategy
CONOPS	Concept of Operations
COTS	Commercial Off-the-Shelf
CSEL	Combat Systems Engineering Laboratory
CTAPS	Contingency Tactical Air Control System (TACS) Automated Planning System
DCP	Dynamic Collaborative Planning
DIS	Distributed Interactive Simulation
EDP	Electronic Data Processing
ELB	Extended Littoral Battlespace
FBE-E	Fleet Battle Experiment-Echo
FDDI	Fiber Distributed Data Interface
FTP	File Transfer Protocol
GCCS	Global Command and Control System
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
INMARSAT	International Maritime Satellite
IP	Internet Protocol
IP-in-IP	IP Encapsulation for use with IP Tunnels
ISO	International Standards Organization
IT	Information Technology
IT-21	Information Technology for the 21st Century
JAOC	Joint Air Operations Center
JHU/APL	Johns Hopkins University/Applied Physics Lab
JMCIS	Joint Maritime Command Information System
JTW	Joint Targeting Workstation
Kbps	Kilobits per second
LAN	Local Area Network
LAWS	Land Attack Warfare System
MAC	Machine Access Code
MBC	Maritime Battle Center
Mbps	Megabits per second
METOC	Meteorologic and Oceanographic
MOSC	Modeling & Simulation (M&S) Operations Support Cell
MR	Multicast Router
MROUTE	Multicast Route(r)
MTF	Message Text Format
NAT	Network Administration Tool
NES	Network Encryption System

Acronym	Definition
NFS	Network File System
NIC	Network Interface Card
NIPRNET	Non-secure Internet Protocol Router Network
NIU	Network Interface Unit
OTCIXS	Officer-in-Tactical Command Information Exchange System
PDU	Protocol Data Unit
POP	Post Office Protocol
PST	Portable Surface Terminal
RTP	Real Time Protocol
SATCOM	Satellite Communications
SBBL	Sea-Based Battle Lab
SCI	Sensitive Compartmentalized Information
SHF	Super High Frequency
SIPRNET	Secret Internet Protocol Routed/Router Network
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SPAWAR	Space and Naval Warfare Systems Command
SSC-SD	SPAWAR Systems Center, San Diego
TADIXS	Tactical Data Information Exchange Service/System
TAMPS	Tactical Aircraft/Automated Mission Planning System
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TEMPMOD	Temporary Modification
TMD	Theater Missile Defense
TMDI	Theater Missile Defense Initiative
TRE	Terminal Receive Equipment
UDP	User Datagram Protocol
ULPDB	Unit Locator and Purpose Database
WAN	Wide Area Network
WeCAN	Web Centric ASW Network
WMD	Weapons of Mass Destruction
WWW	World Wide Web